Nelson North Wastewater Treatment Plant Consent Renewal – Assessment of Discharges to Air

Prepared for

Nelson City Council

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Limitations:

This report has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Nelson City Council and [others (not directly contracted by PDP for the work)], including Stantec. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the report. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

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Executive Summary

Pattle Delamore Partners Limited (PDP) has been engaged by Nelson City Council (NCC) to undertake an assessment of air quality effects relating to odour discharges, combustion discharges from the emergency generator, and greenhouse gases (GHGs) at the Nelson North Wastewater Treatment Plant (NWWTP). This assessment contributes to a wider scope by work undertaken by Stantec New Zealand (Stantec) on behalf of NCC to reconsent the NWWTP.

PDP summarised GHGs from previous measurements and estimations undertaken for NCCs GHG inventory and concludes that the impact of GHGs from this proposal are assessed as neutral due to there being no fundamental change in the wastewater treatment operations as a part of this renewal.

Screen3 (version 4.0.1), a conservative screening model developed by the United States Environmental Protection Agency, has been used to approximate the ground level concentrations associated with the generator discharge. It is predicted that the effects of discharges from the generator will be negligible.

PDP has also have undertaken site visits to the NWWTP and carried out a FIDOL assessment to assess the potential effects of odour to be offensive and objectionable beyond the boundary of NWWTP. It was determined that for most sensitive receptors the risk of experiencing offensive or objectionable odour is considered to be very low.

However, for the public coastal walkway and carpark directly adjacent to the inlet screens at Boulder Bank Drive there is currently the potential for offensive or objectionable odour effects to be experienced. This is because there is currently insufficient extraction at the inlet works to capture odours. NCC has been progressing works to improve the capture and treatment of odour from this source and PDP considers that if these works are done correctly, it will appropriately mitigate odour effects. Therefore, on the basis that PDP's recommendations in Section 8.0 are implemented along with continuation of existing mitigation and management, offensive and objectionable odour effects are not expected to be experienced beyond the boundary of the property.

The main recommendations to mitigate odours are:

- Improving air extraction capacity to draw more air from the wet well through biofilter treatment;
- Upgrading and increasing the size of the biofilter to improve odour treatment capacity once air extraction capacity is increased if the biofilter cannot accommodate the increased flows;
- Seeding the trickling filter prior to start-up when pond loading is high, and the pre-treatment facility is required; and
- Improving clarifier cleaning procedures to practically remove residual wastewater from the base once emptied to avoid this aging and generating odours on start-up during the next high loading period.

Glossary and Abbreviations

Table 1: Glossary and Abbreviations	
Glossary / Abbreviation	**Full Name/Description**
AAQG	National Ambient Air Quality Guidelines
AEE	Assessment of environmental effects. The document to support new resource consents application
AS	Activated sludge
Biosolids	The term used to refer to appropriately treated sludge that can be beneficially used on land
BOD_5	Five day biochemical oxygen demand
BPO	Best practicable option. In terms of the Resource Management Act 1991 and in relation to a discharge of a contaminant or an emission of noise, means the best method for preventing or minimising the adverse effects on the environment having regard, among other things, to: a. The nature of the discharge or emission and the sensitivity of the receiving environment to adverse effects; b. The financial implications, and the effects on the environment, of that option when compared with other options; and The current state of technical knowledge and the likelihood that the option can be successfully applied
$cBOD_5$	Carbonaceous biochemical oxygen demand ($cBOD_5$) (measured as 5 day standard test) this is a measure of the organic strength or load of wastewater, $cBOD_5$ = BOD = BOD_5 = cBOD in this Report and the associated references
Consultation	The communication of a genuine invitation to give advice, feedback and a genuine consideration of that advice and feedback
Contaminant	In terms of the Resource Management Act 1991, includes any substance (including gases, liquids, solids, and micro-organisms) or energy (excluding noise) or heat, that either by itself or in combination with the same, similar or other substances, energy, or heat – a. When discharged into water, changes or is likely to change the physical, chemical, or biological condition of water; or b. When discharged onto or into land or into air, changes or is likely to change.
Discharge	Includes emit, deposit, and allow to escape
DO	Dissolved oxygen
Effect	Effect means – In this Act (Resource Management Act 1991), unless the context otherwise requires, the term 'effect' includes –

Table 1: Glossary and Abbreviations	
Glossary / Abbreviation	**Full Name/Description**
	a. Any positive or adverse effect; and b. Any temporary or permanent effect; and c. Any past, present, or future effect; and d. Any cumulative effect which arises over time or in combination with other effects – regardless of the scale, intensity, duration, or frequency of the effect, and also includes – e. Any potential effect of high probability; and f. Any potential effect of low probability which has a high potential impact.
Environment	Environment, in terms of the Resource Management Act, includes - a. "Ecosystems and their constituent parts, including people and communities; and b. All natural and physical resources; and c. Amenity values; and d. The social, economic, aesthetic, and cultural conditions which affect the matters stated in paragraphs (a) to (c) of this definition or which are affected by those matters"
GHG	Greenhouse gas such as methane and carbon dioxide
Infrastructure	Networks, links and parts of facility systems, as in transport infrastructure (roads, rail, parking, etc.) or water system infrastructure (pipes, pumps and treatment works etc.)
m	Metre as a measure of length
m/s	Metres per second (a measure of speed)
m^3	Cubic metre as a measure of volume
m^3/h	Cubic metres per hour (a measure of flow rate)
MfE	Ministry for the Environment
N	Nitrogen
NAQP	Nelson Air Quality Plan
NCC	Nelson City Council
NES	National Environmental Standard
NWWTP	Nelson North Wastewater Treatment Plant
O&M	Operation and maintenance
OD	Scheme with additional odour management
PF	Peak flow on an hourly basis (m^3/h)
pH	Measure of acid or base nature of liquid

Table 1: Glossary and Abbreviations	
Glossary / Abbreviation	**Full Name/Description**
PS	Pump station
Residuals	The by-product from wastewater treatment such as screenings, sludge, biosolids, noise, odour and other air emissions
RMA	Resource Management Act 1991
Sewerage System	Same as Wastewater Scheme or Wastewater System, the system of pipes, pump stations, treatment and disposal facilities which convey wastewater. These are the component parts of a Wastewater Scheme
SS	Suspended solids, same as total suspended solids (see TSS)
Tāngata whenua	In relation to a particular area, means the iwi, or hapu, that holds mana whenua over the area
TN	Total nitrogen
Trade waste	The liquid wastes discharged by trade premises that produce wastewater as a result of their processes. These industries are commonly called 'wet' industries. Trade waste is the terminology used in the Local Government Act 2002
Treated Wastewater	Wastewater treated to a specified quality
TSS	Total suspended solids = suspended solids (TSS = SS)
Wakapuaka Flats	old estuarine mudflat and saltmarsh area surrounding the wastewater treatment plant
WAS	Waste activated sludge
Wastewater	The mix of domestic sewage, trade waste (industrial wastewater), and unfortunately particularly at rainfall times rain water and groundwater
Wastewater system	Same as Sewerage System. The system of pipes, pump stations, treatment and disposal facilities which convey, treat and discharge wastewater
WW	Wastewater
WWF	Wet Weather Flows
WWTP	Wastewater treatment plant

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1.0 Introduction

Pattle Delamore Partners Limited (PDP) has been engaged by Nelson City Council (NCC) to undertake an assessment of air quality effects relating to odour and combustion discharges and greenhouse gases at the Nelson North Wastewater Treatment Plant (NWWTP). This assessment will contribute to a wider scope by work undertaken by Stantec New Zealand (Stantec) on behalf of NCC to reconsent the discharges that occur at/from the NWWTP as the existing consents for these activities are expiring.

1.1 Purpose

The purpose of this report is to provide NCC with an assessment of environmental effects related to:

- any offensive and objectionable effects from odour; and
- the impact of greenhouse gas discharges;

associated with the NWWTP.

1.2 Overview

The NWWTP is located on Boulder Bank Drive which is situated along the coastline northeast of Nelson City. Figure 1 shows aerial imagery of the area surrounding the NWWTP, including its associated ponds and wetlands.

Figure 1: Aerial imagery of Nelson NWWTP ponds (Google Earth, 2023)

2.0 Background

2.1 History

The NWWTP is owned by NCC and has been operated by Nelmac since 2011. The NWWTP receives primarily domestic wastewater from the northern catchment of Nelson, treats the wastewater primarily via an oxidation pond-based system, and discharges treated wastewater to Tasman Bay via an ocean outfall.

Historically wastewater from Nelson was discharged without treatment into Boat Harbour. In the 1960s, new pumping stations and an ocean outfall were constructed to convey the wastewater to North Nelson, with untreated wastewater discharged into Tasman Bay at the current location from 1970.

The current oxidation pond was established in 1979 to treat wastewater prior to discharge into Tasman Bay. In 1996, the oxidation pond was sub-divided into two interlinked ponds to improve the treated wastewater discharge quality, however, the resulting organic loading on the primary pond (14 ha) was too high, so the pond system reverted to one pond (26 ha) in 2000. The pond system was originally installed without upfront pre-treatment.

The NWWTP underwent its most recent upgrade in 2007-2009 to comply with the current resource consents and increase the plant capacity to accommodate the anticipated population increase. The upgrade included a new pre-treatment facility (i.e., primary clarifier, trickling filter, flow buffer), partitioning of the existing oxidation pond into 16 ha facultative and 10 ha maturation areas, and a new downstream wetland.

Minor modifications at NWWTP have occurred since, including addition of aerators and monitoring probes (for dissolved oxygen (DO), and oxidation-reduction potential (ORP)) in the facultative pond and covering the Trickling Filter (TF). The facultative pond was desludged in 2014, with sludge initially stored on-site in geobags in the flow buffer area and then disposed off-site at the landfill. The flow buffer area was taken offline while used to store sludge and then returned to its original purpose of providing flow buffering when all the stored sludge had been removed.

There have also been upgrades to the wastewater network. Recent upgrades include pipe relining to reduce inflow and infiltration and addition of screening at one of the main pump stations (Neale Park).

2.2 Process Description

The NWWTP receives wastewater from the northern catchment of Nelson, which is primarily residential with a small percentage of commercial/industrial discharges. The NWWTP is an oxidation pond-based treatment system, comprising preliminary treatment (grit removal and screening), pre-treatment (clarification and TF used as required), facultative pond, maturation pond and wetland system. Treated wastewater is discharged via an ocean outfall into Tasman Bay.

The plant is designed to:

- Remove gross solids at the inlet works.
- Buffer peak flow at the inlet works (diurnal peaks) and flow buffer pond (wet weather flows)
- Pre-treat raw wastewater for Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS) removal, as and when required for pond health.
- Pond-based treatment for BOD and TSS removal.
- Disinfection using the maturation pond and wetland system.

The current plant operations reflect the relatively low influent loads typically received at NWWTP. As a result, the pre-treatment facility is usually offline and, despite this, the Facultative Pond is typically underloaded most of the year. Figure 2 outlines the process flow at the NWWTP.

Appendix A provides a high-level summary of the current plant operations. It is based on the Process Capability Assessment prepared by Stantec (2022).

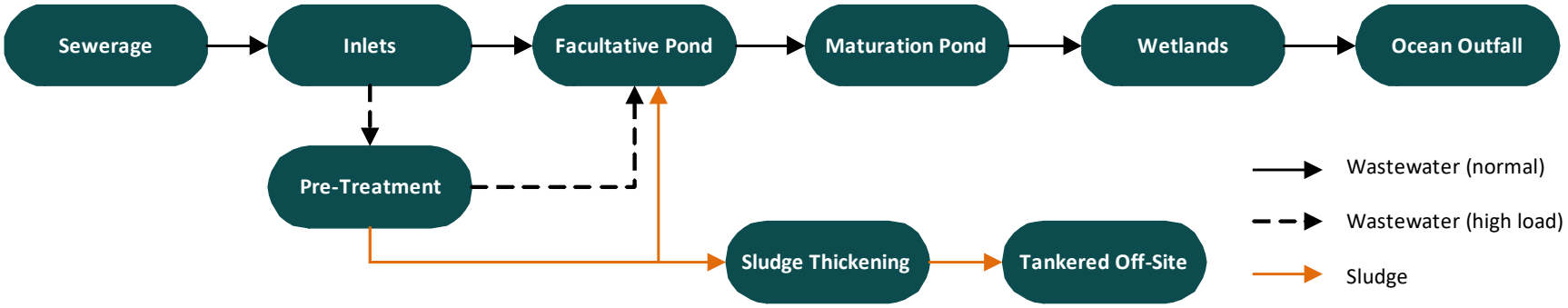


Figure 2: Simplified process flow diagram of the NWWTP

2.3 Odour Control

The Odour Control System was designed to extract and treat air from equipment and areas that may emit malodours or require ventilation. The duty / standby odour extraction fans extract air from the following process areas: Inlet Channel, Inlet Pump Station, TF, Unthickened Sludge Storage Tank, and Thickened Sludge Storage Tank. A simplified process flow diagram for the air extraction system is provided in Figure 3.

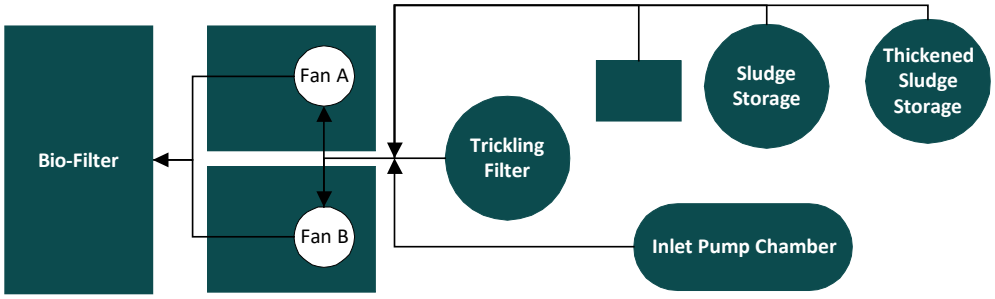


Figure 3: Process Flow Diagram of the Air Extraction Odour Control System

A scrubber system is installed to extract odours and Hydrogen Sulphide (H_2S) from the Rotary Drum Thickener and Thickener Room.

The highest demand on the Odour Control System is the TF when it is in operation; it requires a minimum air supply to meet the process requirements. The extracted air is then passed through a bark biofilter, where it is treated via a combination of adsorption and microbial action. An irrigation system is used to maintain optimal humidity/saturation within the biofilter.

2.4 Consent Renewal

The NWWTP has a number of resource consents associated with its operation, including a coastal permit that authorises the discharge of treated wastewater to the Tasman Bay which is due to expire 1 December 2024.

Stantec has been engaged by NCC to undertake a Process Capability Assessment (PCA) of the NWWTP to inform the reconsenting process. The design horizon adopted is to 2058 or 2059 (depending on when the consent is granted), which is based on a reconsenting horizon of 35 years. PDP has been engaged to assist this process in preparation of supporting information for the assessment of environmental effects relating to air quality.

The NWWTP has three potential types of discharges to air, the predominant discharge being odour from the NWWTP operations, the second being discharge of contaminants to air from an emergency generator, and finally there will also be discharges of greenhouses gases (GHG) associated with the operation of the NWWTP.

3.0 Air Discharges

There are three potential discharges to air from the NWWTP, which are: odour; emergency generator emissions; and greenhouse gases generated from operation of the NWWTP. The proposal regarding each of these discharges is presented below.

3.1 Odour

The consent renewal proposes to continue to operate the WWTP as existing with minor odour management upgrades. There will be no fundamental changes to the treatment processes or systems, however PDP has made some recommendations for reductions in odour emissions which are set out in Section 7.4.

The following sources/locations for potential odour have been identified in the existing NWWTP:

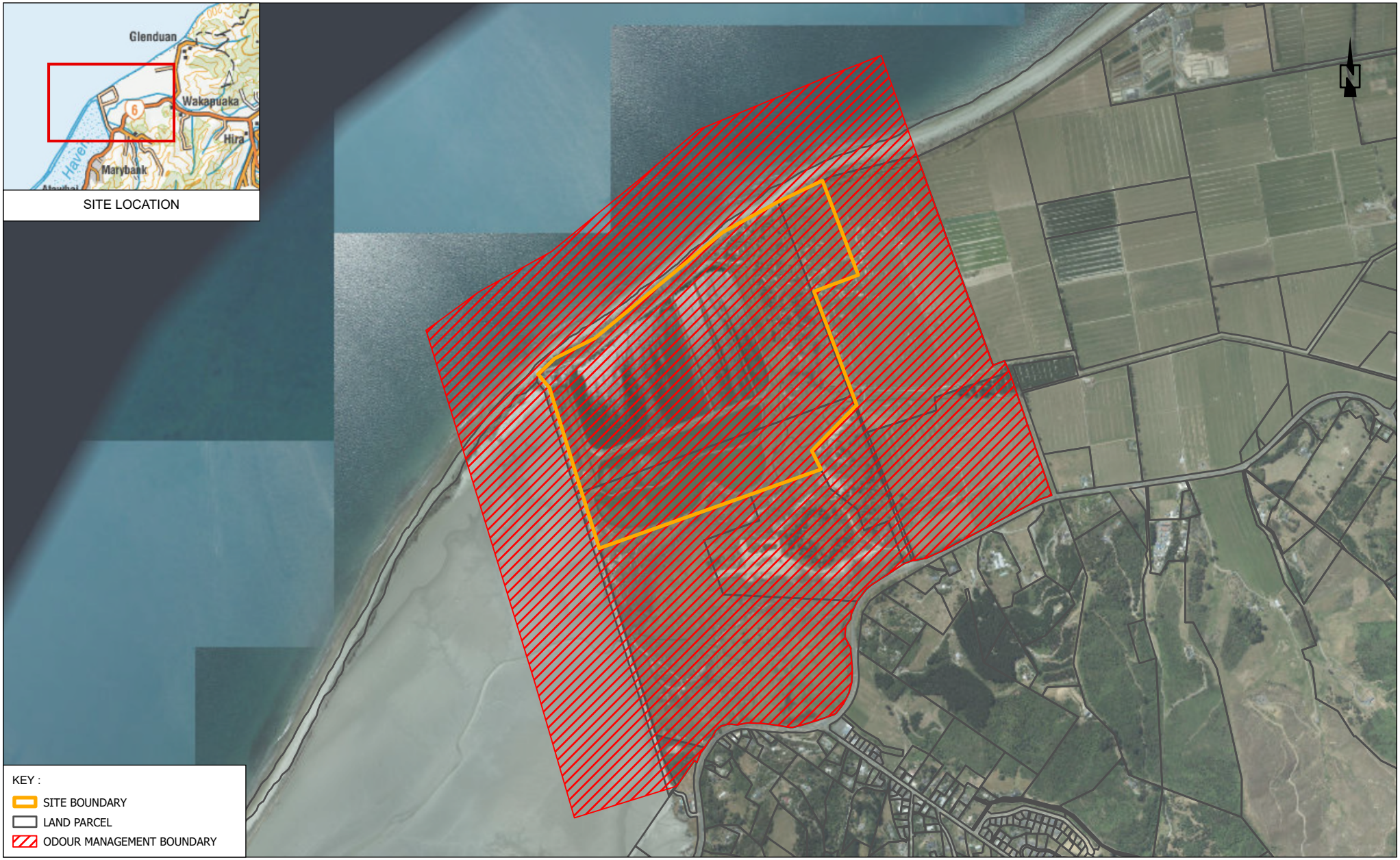
- Inlet Channel
- Inlet Pump Station
- Screens
- Primary Clarifier
- Trickling Filter
- Biofilter
- Unthickened Sludge Storage Tank
- Rotary Drum Thickener
- Thickener Room
- Thickened Sludge Storage Tank
- Facultative Pond (P1)
- Maturation Pond (P2)
- Wetlands
- Final Wastewater Channel
- Desludging Procedures

These odour sources are of small scale and loads in comparison to other larger WWTPs which process more trade waste and higher loads. Due to the age and simplicity of the NWWTP, the security fencing is very close to the treatment components and public access is allowed in the WWTP site boundary to allow public access to the coastline. In new WWTPs larger separation distances would be maintained between public amenity areas and WWTPs, however the NWWTP as existing would be difficult to change without blocking valued public access to the coastline.

Condition 6 of the existing consent prohibits objectionable or offensive odours "…at any point on or south of State Highway 6". This wording would potentially allow odour to be experienced all the way east to, and beyond, Glenduan as well as within all of the Nelson Haven. It is considered that a better odour buffer should be defined, with the suggested area shown in Figure 4 and called the "Odour Management Boundary".

The rational for this area is that it is based on the shortest distance to State Highway 6 (based on the extent of the existing buffer) and therefore effectively provides the same level of protection to the NWWTP, while removing the anomaly discussed above for residents in the area. PDP has also considered the underlying land parcels when developing the odour buffer and adjusted the boundaries of the proposed buffer to encapsulate parcels, rather than bisect them. This approach is similar to that used to define the boundary of airsheds

This proposal assesses effects from the NWWTP site boundary to be conservative with the Odour Management Boundary proposed for the purposes of consenting to allow for occasional localised odours which cannot be avoided from the operation of an WWTP such as NWWTP.



SOURCE:
1. AERIAL IMAGERY (FLOWN 2022) SOURCED FROM THE LINZ DATA SERVICE (https://data.linz.govt.nz/search/?q=nelson+aerial) AND LICENCED BY LINZ DATA SERVICE FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 INTERNATIONAL LICENCE.
2. PROPERTY PARCELS SOURCED FROM LINZ.

FIGURE 4 : ODOUR MANAGEMENT BOUNDARY

SCALE : 1:18,000 (A4)
0 50 100 200 300
METRES

3.2 Generator Air Discharges

The NWWTP has a diesel powered generator 285 kVA (~228 kW) emergency generator located on site to allow the site to operate in power outages. NCC proposes to maintain this generator onsite for emergency purposes. This means that the generator will be run for regular maintenance checks as well as in the circumstances of an emergency power outage. The generator is typically tested for maintenance checks for around 30 minutes once a month. The generator building is shown in Figure 5 together with its horizontal exhaust stack.

Figure 5: Photo of the generator building (left) and horizontal exhaust (right)

3.3 Greenhouse Gases

Greenhouse gases directly associated with operation of the NWWTP will remain unchanged as no fundamental changes to the treatment system, energy requirements or transport needs are proposed. The GHGs associated with NWWTP, and impacts are summarised in Section 7.3.

4.0 Existing Environment

4.1 Site Description

The NWWTP located at Boulder Bank Drive in Nelson and due to its location, is sometimes referred to as the Wakapuaka Wastewater Treatment Plant.

Table 2: Site Details	
Owner	Nelson City Council
Operator	Nelmac
Land Parcels	Lot 3 DP 7530, Lot 1 DP 13614, Lot 1 DP 7276
Co-ordinates	NZTM 1627593 E 5438522 N

4.2 Meteorology

Data was obtained from both the Nelson Automatic Weather Station (AWS) from January 2013 to March 2023 and the onsite anemometer at the NWWTP from Nelson is presented in a windrose in Figure 6 and that from NWWTP is presented in Figure 7.

The predominant wind directions are from the southwest and northeast, with a significant presence of lower speed sea breezes from the northwest at the NWWTP compared to Nelson. These differences are potentially due to the Nelson being more sheltered from sea breezes by the land masses to the west, which are not present at the site. The average wind speeds in Nelson are 3.3 metres per second (m/s), with calms[1] 2.3% of the time and 4 m/s, with calms[2] 0.3% of the time at the NWWTP. Again given the exposed nature of the NWWTP the stronger winds and lower calms are expected.

Temperature and rainfall data were also analysed as these parameters can contribute to air quality issues such as odour as high temperature can exacerbate bad odour, however rainfall can help to mitigate odours as volatiles are sequestered. Average hourly temperatures above 25°C are recorded 0.35% of the time and hourly rainfall above 1 mm is recorded 3.1% of the time.

[1] Defined as winds less than 0.5 m/s
[2] Defined as winds less than 0.5 m/s

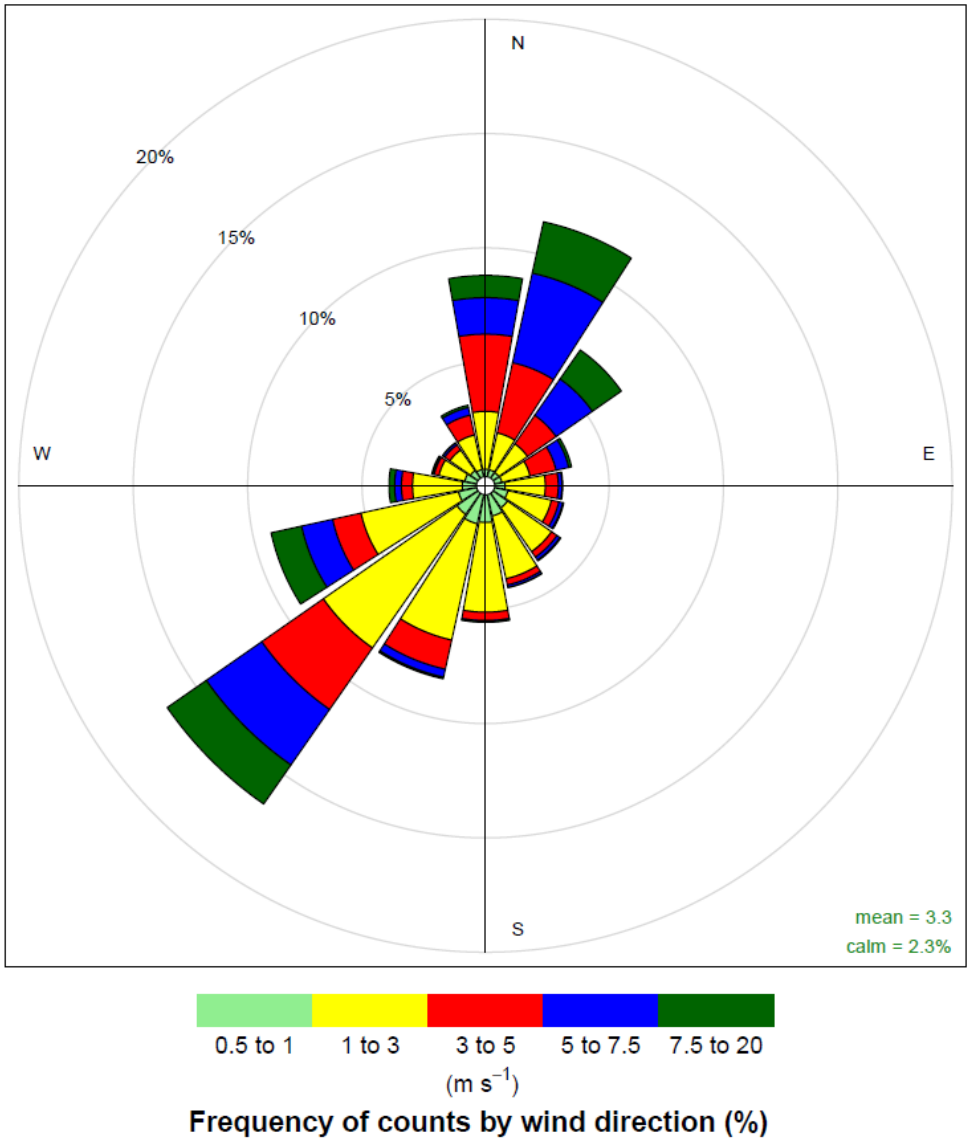


Figure 6: MetService weather station 4271 Nelson AWS 2013 – 2023

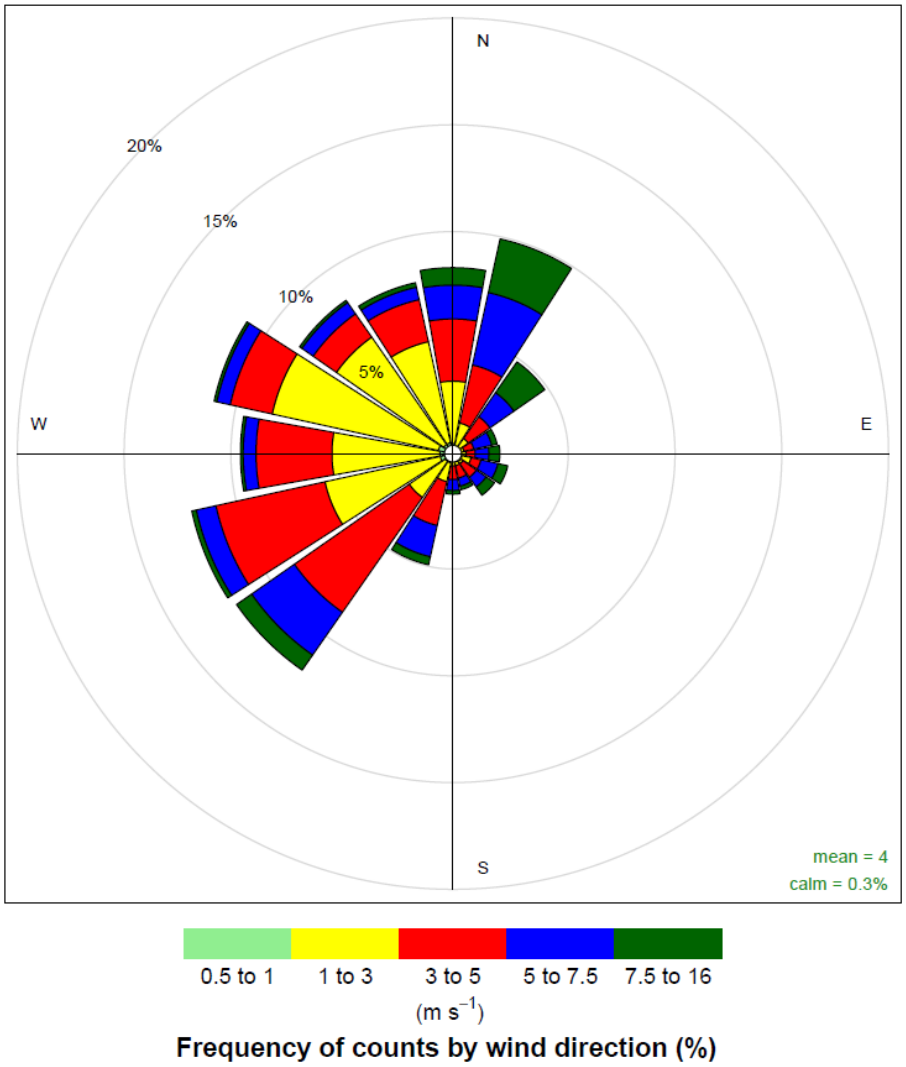


Figure 7: NWWTP onsite weather station 2017 – 2023

4.3 Potential Sensitive Receptors

Table 3 sets out the closest properties that have been identified adjacent to the NWWTP designation and are within the Odour Management Boundary. Notably neighbouring properties range from rural land use to reserve and coastal recreational areas. Public coastal recreational areas along Boulder Bank Drive and the beach have most potential to be sensitive receptors to odour from the NWWTP. Rural and reserve land are also likely to have some sensitivity to odour if people are present in those areas. The level of sensitivity of these properties and whether they can be classified as a sensitive receptor is discussed in Section 7.1.5.

Properties further away than the Odour Management Boundary also have potential to be sensitive receptors if there are significant odour events, however the greatest potential for effects will be to those properties closest and therefore if effects assessed in Section 7.0 demonstrate that the risk for effects on the closest sensitive receptors is low then any effects on receptors further away will also be low.

Table 3: Properties Adjacent to the NWWTP

Sensitive Receptor	Land Use	Legal Description	Direction from NWWTP	Distance to NWWTP boundary (m)
Nelson City Council (Applicant)	Scenic Reserve Boulder Bank	Part Section 1 SOP 14733	N	0
	Road (Boulder Bank Road)	Lot 1 DP 7530/ Lot 1 DP10699	W	0
	Wakapuaka Sandflats Esplanade	Lot 1 DP 14320	S	0
	Wakapuaka Sandflats Esplanade	Lot 1 DP 7276	SE	0
His Majesty the King	Wakapuaka Sandflats Esplanade	Pt Lot 4 DP7530	S	0
Nelson Port	Wakapuaka Sandflats Esplanade	Lot 1 DP 5602	SE	0
The Proprietors of Wakatu	Rural land	Pt Lot 1 DP 7185	SE	95
AA Singleton A R Higgins	Rural land	Lot 1 DP 7656	E	10

A map and addresses of the potential sensitive receptors listed in Table 2 are presented in Figure 8.

SOURCE:
1. AERIAL IMAGERY (FLOWN 2022) SOURCED FROM THE LINZ DATA SERVICE (https://data.linz.govt.nz/search/?q=nelson+aerial) AND LICENCED BY LINZ DATA SERVICE FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 INTERNATIONAL LICENCE.

FIGURE 8 : MAP OF NWWTP AND NEIGHBOURING PROPERTIES

SCALE : 1:18,000 (A4)

0 50 100 200 300

METRES

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4.4 Complaints History

Between 2013 and 2018 there were 74 complaints registered regarding odours from the NWWTP. These predominantly related to odours from the ponds, in particular major events included:

- March 2013 where many residents complained due to odours caused due to parasitic infection of algae (the trickling filter was operated and the ponds were seeded to deal with the imbalance).
- March 2015 where residents complained due to odours caused by ponds out of balance with load, or seasonal change (Sodium nitrate was added to the ponds, and monitoring was undertaken).
- May 2016 where residents complained due to odours caused by ponds coming from the temporary pipeline installed for remedial works for NCC (seeding and aeration was undertaken).
- October 2018 where residents complained due to odours caused by the ponds due to an algal infection which depleted oxygen producing algae (pre-treatment plant was used, sodium nitrate added, hydrobiologist contacted, increased monitoring, seeding and desludging was implemented).

The most notable recent event is the significant pond odour failure in October 2018 (Labour weekend). Prior to the event, the facultative pond largely contained a monoculture of Euglena with a low level of infection (1% to 6% of population infected). Over the course of three days, the level of infection increased exponentially, ultimately wiping out the Euglena population. The sudden loss of the main oxygen producing algae in the pond saw a marked drop in pond dissolved oxygen and ORP, a change in pond colour, and a production of strong odours which drifted well beyond the site boundary, with odour complaints received from 23 October to 1 November.

The Pond Management Team (PMT) responded by:

- algae seeding (from the wetlands as well as tankering of algae from Bell Island WWTP);
- sodium nitrate dosing; and
- 'full' pond deloading by running the pre-treatment facility with sludge treatment and thickened sludge tankered off-site.

These measures saw the ponds recover quickly, with a marked improvement in pond health seen within two weeks such that algal seeding was ceased and then about a week later pond loadings were returned to normal. Following this event, the PMT reviewed its procedures and has taken a more proactive approach to minimise the risks of a similar event occurring. Pond management to avoid events like these in the future is further addressed in Section 6.5. There have

been no further instances of major odour events from the ponds since 2018 and the implementation of increased management measures.

5.0 Assessment Criteria

5.1 Odour Assessment

The following documents have been used to form the assessment methodology to assess the potential odour effects of the proposed activity:

- Ministry for the Environment (MfE) Good Practice Guide for Assessing and Managing Odour, 2016 (GPG Odour); and
- Institute of Air Quality Management (IAQM) Guidance on the assessment of odour for planning, Version 1.1, 2018. (IAQM Guide).

The assessment methodologies that have been adopted from each of the assessment criteria listed above are described in more detail below.

5.1.1 MfE Good Practice Guide for Assessing and Managing Odour

The MfE GPG Odour (Ministry for the Envionment, 2016) identifies the following assessment tools for a resource consent application for new or modified facilities have been selected for use for assessing the effects of odour at the Nelson NWWTP:

- Experience and knowledge from other sites of a similar nature, scale and location, including consideration of appropriate separation distances;
- Site management and contingency plans, and whether the best practicable option is being applied;
- Process controls and design, including details of emission controls and engineering risk assessment for system failures; and
- Analysis of site-specific meteorology and topographical features.

The MfE GPG Odour also recommended the three additional tools below which PDP has not selected for use at this stage due to the nature of the activity. These tools could be used to further quantify the effects and develop community focused solutions if the risk of the activity to cause objectionable and offensive effects was found to be high as a result of the FIDOL assessment:

- Community consultation;
- Dynamic dilution olfactometry measurements and odour dispersion; and
- Air dispersion modelling.

Under the Resource Management Act, the primary concern with odour is its ability to cause an effect that could be considered ‘offensive or objectionable’. Whether an odour has an offensive or objectionable effect requires an overall

judgement that considers the frequency, intensity, duration, offensiveness / character, and location of the odour event. These are known as the FIDOL factors and are presented in Table 4. Appendix AQ10 of the Nelson Air Quality Plan also endorses the use of the FIDOL tool for assessing the potential for odour to be offensive or objectionable.

Table 4: Description of the FIDOL Factors (MfE, 2016)	
Frequency	How often an individual is exposed to the odour.
Intensity	The strength of the odour.
Duration	The length of exposure.
Offensiveness/character	The character relates to the 'hedonic tone' of the odour, which may be pleasant, neutral or unpleasant.
Location	The type of land use and nature of human activities in the vicinity of an odour source.

Odours may occur frequently in short bursts, or for longer, less-frequent periods, and may be defined as having 'acute' or 'chronic' effects.

Depending on the severity of the odour event, one single occurrence may be sufficient to consider that a significant adverse effect has occurred. In other situations, however, the event may be short enough, and the impact on neighbours sufficiently minor, that the events would need to be happening more frequently for an adverse effect to be deemed to have occurred.

A FIDOL assessment in accordance with the MfE GPG odour has been used as the basis of this assessment methodology.

5.1.2 IAQM Guidance on the Assessment of Odour for Planning

The IAQM Guide (Institute of Air Quality Managment, 2018) indicates that an assessment of the impact and resulting effects of an odour source on surrounding users of the land will usually contain the following major elements:

1) A description of existing baseline odour conditions (including complaints history) where relevant.

2) A description of the location of receptors and their relative sensitivities to odour effects.

3) Details of potential odour sources (whether existing or proposed), including the activities and materials involved (including a brief outline of quantities, durations, methods of handling and storage, etc) and the resulting potential for generating odours, covering fugitive sources, diffuse sources and point sources as applicable.

4) A description of control/mitigation measures incorporated into the scheme (including management controls and, where appropriate, engineering controls).

5) A prediction or observation (or combination of both), using appropriate assessment tools, of the likely odour impact and resulting effects at relevant sensitive receptors, and taking into account:

   a. the likely magnitude of odour emissions (after control by measures incorporated into the scheme, if applicable);

   b. the likely meteorological characteristics at the site;

   c. the dispersion and dilution afforded by the pathway to the receptors and the resulting magnitude of odour that could result;

   d. the sensitivity of the receptors; and

   e. the potential cumulative odour effects with any odours of a similar character, (e.g. if odours from kitchen waste are in addition to an existing municipal solid waste throughput.)

6) Where odour modelling has been used the reports should contain full details of the input data and modelling options used to allow a third party to reproduce the results.

7) Where odour effects are assessed as significant, details of appropriate further mitigation and control measures that could allow the proposal to proceed without causing significant loss of amenity.

8) The residual odour impacts and their effects.

9) A conclusion on the significance of the residual effect, i.e. whether “significant” or “not significant”.

The IAQM Guide notes that to make the predictions or observations in Point 5 above, Air Quality Practitioners need to use at least one odour assessment tool that takes the FIDOL factors into account.

The methodology section of IAQM Guide recommends that the Air Quality Practitioner should justify the following:

- why the chosen odour assessment tools have been used and why they are suitable for the assessment in question; and
- that the approach used is of a depth and rigour consistent with the likely risk of adverse effects.

5.1.3 Assessment Methodology

This assessment is prepared in accordance with good practice adopting the approach from both the MfE GPG Odour and IAQM guidelines. This report therefore includes the following information to align with the recommendations of the above assessment criteria:

- Description of the proposed Activity including:
  - Site management and contingency plans, and whether the best practicable option (BPO) is being applied (Section 6.0);
  - Process controls and design, including details of emission controls and engineering risk assessment for system failures (Section 2.2);
  - Details of potential odour sources (Section 3.1);
  - A description of control/mitigation measures incorporated into the existing NWWTP (Section 6.0); and
  - Experience and knowledge from other sites of a similar nature, scale and location, including consideration of appropriate separation distances (Section 3.1).
- Description of the Existing Environment including:
  - Analysis of site-specific meteorology and topographical features (Section 4.2);
  - A description of existing baseline odour conditions (including complaints history) where relevant (Section 3.1 and 4.4); and
  - A description of the location of receptors and their relative sensitivities to odour effects (Section 4.3).
- Assessment of Environmental Effects including:
  - A prediction or observation (or combination of both), using appropriate assessment tools, of the likely odour impact and resulting effects at relevant sensitive receptors (Section 7.0).
- Conclusion including:
  - The residual odour impacts and their effects (Section 7.1.6 and 7.4); and
  - A conclusion on the significance of the residual effect, i.e. whether “significant” or “not significant” (Section 7.4).

For existing activities, the MfE guidance puts less emphasis on atmospheric dispersion modelling and more emphasis on reviewing how odour from the activity is currently affecting the local community, their acceptability, and then identifying whether the changes in odour control proposed will make things better or not. Given the nature of the existing activities, a qualitative approach has been taken over a quantitative approach which would incorporate atmospheric dispersion modelling. Therefore, atmospheric dispersion modelling has not been undertaken and a FIDOL assessment in this circumstance is considered to be more appropriate than modelling.

5.2 Generator Air Discharges

The emissions associated with the emergency generator discharges when required for backup electricity in the circumstances of power outages are present to drive pumps and electricity demands. Under AQr.32.1 of the NAQP the discharge of any contaminant into air from combustion within a stationary internal combustion engine is permitted if:

"a) the fuel is gas, liquefied gas, petrol, diesel, vegetable oils or alcohol, and

b) fuel containing sulphur at levels greater than 0.05% by weight is not burned, and

c) no fuels in Rule AQr.20 (Prohibited Fuels) are burnt, and

d)

i) the power output of the device does not exceed 30 kW, or

ii) the power output of the device is between 30 and 400 kW, and

a. the engine is not operated for a total of greater than 5 hours in any 24-hour period, and

b. where the engine is in a fixed location, the stack complies with the requirements in Appendix AQ6, or

iii) the engine is used in an unforeseen emergency to drive a pump, or an electrical generator." (emphasis added)

Therefore, the use of this onsite generator for electricity in emergency circumstances is permitted under clause iii), however use of the generator for maintenance checks is not permitted (as this does not constitute an unforeseen emergency) as the stack does not comply with the requirements of Appendix AQ6 (refer Figure 5). An assessment of the effects of discharges from the generator is therefore required.

5.2.1 Principal Contaminants of Concern

The key contaminants (products of combustion) associated with the operation of the proposed diesel generator include:

- Particulate matter (as PM_{10});
- Particulate matter (as $PM_{2.5}$);
- Nitrogen dioxide (NO_2); and,
- Carbon monoxide (CO);

Fine and coarse particles that are less than 10 µm in size (PM_{10}) have the potential to be inhaled deep into our lungs and cause wide ranging health and respiratory problems. The main source of PM_{10} in urban areas is home heating, but industry and transportation also emit PM_{10}. There are currently no ambient air quality standards or guidelines in New Zealand for particles less than 2.5 µm in diameter ($PM_{2.5}$ or fine particles). Key health effects associated with PM_{10} exposure include: mortality, morbidity, hospitalisation, work-affected days and increased use of medication.

Exposure to NO_2 has the potential to aggravate asthma symptoms and reduce lung development in children. The main source of NO_2 near NWWTP is likely to be vehicle emissions, home heating and from the NWWTP site itself. Overall background NO_2 in the rural environment is expected to be low. Key health effects associated with NO_2 exposure include: apparent contribution to morbidity and mortality, especially in susceptible subgroups, including young children, asthmatics and those with chronic inflammatory airway disease.

Exposure to CO has the potential to aggravate heart conditions, and reduce the amount of oxygen received by body tissues. As with NO_2, the main source of CO near NWWTP is likely to be vehicle emissions, although home heating and industry also emit CO, again noting these levels are likely to be low due to the rural setting. Key health effects associated with CO exposure include: reduced birth weight (non-smoking mothers), decreased work capacity, increased duration of angina (for those with ischaemic heart disease), decrease in visual perception, decreased manual dexterity, and decreased ability to learn.

The principal contaminant of concern in this assessment is NO_2 discharged from the generator.

5.2.2 National Environmental Standard for Air Quality

The National Environmental Standard for Air Quality (NESAQ) refers to the ambient air quality standards for contaminants under Section 13 and 14

The ambient air quality standard for a contaminant applies at any place that is in the open air and where people are likely to be exposed to the contaminant. These are demonstrated in Table 5 with the number of exceedances allowed.

Table 5: Schedule 1 of the NESAQ Ambient Air Quality Standards

Contaminant	Threshold concentration	Number of exceedances allowed
CO	10 milligrams per cubic metre expressed as a running 8-hour mean	1 in a 12-month period
NO_2	200 micrograms per cubic metre expressed as a 1-hour mean	9 in a 12-month period
PM_{10}	50 micrograms per cubic metre expressed as a 24-hour mean	1 in a 12-month period

5.2.3 National Ambient Air Quality Guidelines

The National Ambient Air Quality Guidelines (AAQGs) were published by the MfE in 2002 following a comprehensive review of international and national research, and are widely accepted among New Zealand air quality practitioners. The AAQG criteria provide the minimum requirements that ambient air quality should meet in order to protect human health and the environment.

Guideline levels for pollutants and averaging periods not covered by the NESAQ criteria still apply. The NESAQ criteria replace any previous guideline levels for that particular pollutant and averaging period. The AAQG criteria set for the protection of human-health for PM_{10}, CO, NO_2, SO_2 and O_3 are presented in Table 6. The AAQG for O_3 is the only criterion which does not apply to this assessment. SO_2 has also not been assessed due to the low sulphur levels expected in diesel fuels.

Table 6: Ambient Air Quality Guidelines

Contaminant	Threshold Concentration ($\mu g/m^3$)	Averaging Period
PM_{10}	50 20	24-hour Annual
CO	30,000 10,000	1-hour 8-hour
NO_2	200 100	1-hour 24-hour

5.3 Greenhouse Gases

GHG considerations have only recently been included for consideration by consent authorities under the RMA and there is little/no policy or guidance for decision making under the RMA on projects with GHG emissions.

GHG emissions have been considered under Fast Track consenting as a requirement of the COVID-19 Recovery (Fast-track Consenting) Act 2020. Section 19(e) of this Act provides for consideration of the potential for significant adverse environmental effects, including greenhouse gas (GHG) emissions. This framework suggests what should be considered for inclusion when considering climate change and indicates the following:

Applicants should provide enough information to determine whether their project is likely to have:

- a significant net *negative* emissions impact (increase in emissions), or
- a significant net *positive* emissions impact (decrease in emissions), or
- a minimal or uncertain emissions impact.

Details of the size and scale of the emissions source or associated activity are required to understand the impact. PDP has therefore adopted this assessment approach and prepared an assessment of effects from greenhouses from the wastewater treatment plant to this effect in Section 7.3 based on existing NCC measurement and GHG reporting work done by NCC to quantify its GHG footprint associated with wastewater to date (Tonkin & Taylor Ltd, 2022).

6.0 Odour Management and Mitigation

NWWTP implements a Nelson Wastewater Treatment Plant Odour Management Plan (OMP)(Nelmac, 2022)(Appendix C) which contains effective mitigation and management for odour on the site. Key mitigation and management measures currently implemented for the NWWTP through the OMP are summarised below. The OMP also refers to the standard operating procedures in the Operation and Maintenance (O&M) manuals for each component, which have been integrated into everyday maintenance to ensure odour is always considered and controlled.

It is assumed that the pre-treatment facility (clarifier and TF) will continue to always be used in periods of high wastewater loading, this is an additional fundamental odour control measure to ensure pond loading is managed and is a part existing operation.

6.1 Primary Clarifier

Operation of the Primary Clarifier is covered in its O&M manual. Specific operational activities to control odour are:

1. Inspect and clean scum boxes weekly.
2. Inspect and clean the central stilling well daily.
3. Inspect overflow weir weekly and clean as required, at least monthly.
4. Scraper arms (sludge and scum) are fitted with fail alarms, for early response to failure.
5. Prevent excessive accumulation of primary sludge in the primary clarifier by managing the depth of the sludge blanket by controlling the rate and frequency of sludge withdrawal to the sludge holding.
6. Proactive maintenance to minimise failure.
7. Removal of accumulated scum in scum wells as required.

6.2 Trickling Filter

One of the primary functions of the TF, aside from the pre-treatment benefits is the ability to remove sulphides from the wastewater which is beneficial from a pond management perspective. The TF is covered with a fiberglass dome and is connected to the site biofilter to extract the gasses, it is important that the biofilter is operational when running the TF as it has a high potential to generate odour that could be offensive or objectionable.

6.3 Rotary Drum Thickener

Operation of the Rotary Drum Thickener (RDT) is covered in the O&M manual for it. This covers routine operation and maintenance procedures that address potential odour caused by incorrect operation. The RDT has a dedicated activated carbon odour system that keeps the sludge (wet) process separated from the rest of the treatment system.

6.4 Facultative Pond

Management of the pond is detailed in the Pond Management Plan. Odour emissions from the pond are generally associated with the disruption of biological processes. Potential causes of this are addressed in the Pond Management Plan, including:

- **Overloading of the ponds**. If inlet BOD loads in the influent to the STP are excessive, then the ponds will become overloaded.
- **H_2S Toxicity**. Even at low concentrations H_2S can be toxic to certain species of algae – an inlet analyser is being installed to monitor H_2S

concentrations. During high periods of H_2S in the inlet the TF can be used to strip sulphide.

- **High TSS loading**. Prolonged periods of shock high TSS loads can impact algae.
- **Fungal attack on algal populations**. If a fungal attack occurs, then the algal populations can completely die off or else be significantly reduced. This reduction can lead to inadequate oxygen formation and reducing conditions beginning to occur. This risk is now the main odour risk factor associated with the ponds and may lead to major odour events, both in magnitude and duration.
- **Seasonal succession of algal species**. This is a natural and inevitable occurrence and gives rise to periodic, relatively minor odour events which will be on-going. A variety of factors are significant, including weather conditions (particularly pond stratification via wind assisted turnover).
- **Sludge build-up in the ponds**. Influent solids settle out within the facultative ponds, and to a lesser extent, the maturation ponds. Overtime this progressively reduces the hydraulic capacity of the ponds and, particularly during warmer months, the sludge contributes an increasing oxygen demand to the water column as it degrades. Desludging of the ponds is a reactive maintenance requirement. Further information is contained in the pond management plan.

The Pond Management Plan is focused on load management and pond performance. Standard operating and maintenance procedures for the ponds are covered in a separate O&M manual.

6.5 Maturation Pond and Wetlands

The maturation pond receives wastewater from the facultative pond and the wetlands receive wastewater from the maturation pond. Provided that the facultative pond is properly managed as described above, the maturation pond and wetlands are highly unlikely to emit odour.

6.6 Biofilters

The plant biofilter is a bark media with fixed sprinkler systems. Operation of the biofilter is covered in detail in the O&M manuals for it.

Moisture content of the media is critical to biological activity. At present this is not monitored, and operator judgement is relied on for moisture control. This can be improved by the use of handheld, moisture meters. A further enhancement could be permanent meters linked to automate sprinkler control.

Media must be maintained at the correct pH level, as sewerage gases are often associated with low pH. pH correction by the addition of granulated lime or similar is recommended. pH measurement of media is carried out 6-monthly by the media supplier in conjunction with AFP (Air fill porosity) to determine the condition of the media. The supplier may recommend some addition of an additive to help correct the pH.

Media effectiveness should be monitored regularly (6-12 monthly intervals) and media should be replaced when shown to be ineffective or at least every three to five years.

Regular inspections of the biofilters are carried out as follows to ensure they are maintained in an operable fashion:

- Weekly monitoring of manometer pressure differential <100 mm.
- Maintaining the bark in a weed free condition by regular weed spraying.
- Visual checks for short-circuiting and turning over the bark at six monthly intervals.
- Six monthly assessment of media pH and AFP to determine when the bark media required to be changed and if addition of lime or similar is necessary. These tests are carried out by the media supplier who provides a recommendation on media quality and when it is required to be replaced.

6.7 Dewatering Room

The dewatering room houses the RDT that can be used to receive primary clarifier sludge. This unit is used periodically on as “as needed” basis when de-loading the ponds. Operation of the RDT is covered in the O&M manual for it. Mitigation is by ventilation of the room and treating the air using activated carbon (AC) scrubber.

It is important to keep external doors and openings closed to minimise risks for odours escaping the room. The AC scrubber operation is covered by its specific O&M Plan, which details proper operation for effective odour control.

6.8 Dredging of Sludge into Geotextile bags

Periodically as part of the pond management is it necessary to dredge the ponds to remove sludge. The following mitigation measures will minimise and reduce odour emissions and will be employed during these works:

- The dredged sludge from the oxidation pond will be transferred directly to geotextile bags using welded pipeline to avoid any odour escaping during the transfer process.

- Regular odour surveys around the boundary of the Odour Management Boundary during the desludging operation. The survey will be conducted by walking along the different sections of the odour management area to ascertain whether there are any odours coming from the desludging operation.
- Regular checks and maintenance of the drainage system to ensure no significant ponding of leachate between the geotextile bags and in the buffer pond.
- Any opened geotextile bag with sludge that has not been transferred to the landfill for disposal will be covered with a well-anchored cover system.
- The contractor will have a Management Plan for the desludging works, which will include a dedicated OMP, with appropriate odour management and mitigation measures included.

In the unlikely event that any significant odour emissions occur as a result of the desludging operation, the following management and mitigation measures will minimise and reduce odour emissions.

- A sprayer which delivers odour masking or suppression compounds will be deployed on an as need-be basis.
- The geotextile bags may be covered with soil/mulch, if required, to minimise odour emissions. Soil/mulch is commonly used as the media for conventional biofilters to treat and remove odour associated with wastewater.

6.9 Improved Odour Control Mechanisms

PDP understands that odour mitigation on site is currently in the process of being improved and acknowledges the following mitigation upgrades.

6.9.1 Increased Air Extraction Capacity

The greatest consistent source of odour closest to the public walkway and carpark at Boulder Bank Drive and along the coastline is the inlet works. Hydrogen sulphide odours are detected from the inlet screens frequently. The inlets are shown in **Figure 9.**

Figure 9: Current inlet covers at NWWTP

An assessment undertaken by Beca in 2019 reviewed the odour management system at the NWWTP and determined that that flow regulation for each source connected to the odour management system was inadequate (Beca Limited, 2019).

This led to upgrades of the sludge room air extraction with the air being treated in a new scrubber system which was installed in 2021 to reduce odour and staff health and safety concerns and therefore increased fan suction capacity to the biofilter for other areas of the NWWTP. The assessment considered that flow from the trickling filter could be restricted, and dampeners with upstream fittings for monitoring equipment should be installed on each extraction point. Flow and vacuum monitoring were recommended at each point to optimise the extraction system and once optimised (Beca Limited, 2019).

Beca also indicated that if adequate air changes could not be achieved, or elevated H_2S concentrations were recorded, that increased air extraction rates should be considered. Sealing deficiencies were also observed, with gaps around warped or poorly fitting covers could be allowing fugitive emissions (Beca Limited, 2019).

Windsor Engineering undertook an investigation of flow balancing after removal of the sludge room ducting following installation for the scrubber system in 2021. This revealed that while a theoretical volume flow of 491 m^3/h should have been gained from capping the ducting, volumes were nowhere near this estimate despite some small gains in extracting gas from the pump inlet chambers. Operational issues such as varying flows, back-flow issues, dampeners, actuators and fans were not operating as inspected and were underperforming (Nelson City Council, Nelmac & Windsor Engineering , 2021). Recommendations were made to undertake further balancing after the shut off damper situation was improved, and Fan A had been replaced.

During the site visits undertaken by PDP on 13 and 14 April 2023 one fan had been replaced to increase air extraction, with another replacement fan for the other extractor also scheduled. The status of the dampener repairs and tuning is unknown. It is possible that after replacement of both fans and repair of the dampeners the air extraction system is sufficient to mitigate odour from the inlets.

However if odour issues are ongoing, PDP recommends the following check and subsequent adjustment. PDP estimates that the design flows (which are not currently achieved) should provide up to 6 air changes[3] from the inlet chambers. The chamber drawings should be checked and if chamber area is greater than this increased air extraction is recommended.

NCC may also want to consider upgraded inlet covers such as hydraulically sealed inlet covers in conjunction with increased air extraction to reduce the leakage of odours from the chambers.

6.9.2 Upgrading the Biofilter to Treat Increased Air

PDP did not detect any H_2S odours from the biofilter which is consistent with the findings by Beca in 2019. However, based on some preliminary calculations, there is the potential that increased air flows may exceed the treatment capacity of the biofilter. The existing biofilter is shown in **Figure 10**.

Figure 10: Existing biofilter (2023)

Should the improved air extraction through the biofilter exceed the treatment capabilities, PDP recommends sizing a deeper and wider biofilter bed for the new air flow rates. This would include adding a wall around the existing biofilter to create sides and increase bed volume to achieve as a rule of thumb < 30 m^3/m^2h.

[3] Based on PDP's estimate of a volume of approximately 145 m^3

In addition to increasing the capacity of the biofilter to treat air, the following methods of odour management are outlined in the existing OMP for NWWTP as ways to improve biofilter management and may to implemented to assist odour control:

- Moisture control: At present this is not monitored, and operator judgement is relied on for moisture control. This can be improved by the use of handheld moisture meters or further enhancement could be permanent meters linked to automatic sprinkler control; and
- Off-gas monitoring of H_2S could be implemented to measure efficacy of biofilter operation.

6.9.3 Other Improvement Options

PDP recommends NCC considers the following options if not presently implemented to improve their odour management onsite in addition to the above upgrades:

- Seeding the trickling filter prior to start-up when pond loading is high and the pre-treatment facility is required; and
- An improved clarifier cleaning procedure to practically remove residual wastewater from the base once emptied to avoid this aging and generating odours on start-up during the next high loading period;

Should site management and contingency plans be implemented as described, and with the improvements outlined in Section 8.0, then these measures are likely to be the BPO applied for the existing site.

7.0 Assessment of Environmental Effects

7.1 Odour FIDOL

To assess the effects of odour a FIDOL assessment has been undertaken in accordance with the methodology outlined in Section 5.1.3.

7.1.1 Frequency

The NWWTP operates everyday throughout the year processing wastewater from the city. Different treatment and/or wastewater storage components may be used intermittently. To better understand the winds that are likely to have an impact on odour emissions in accordance with the IAQM guidelines, the frequency of wind blowing toward the sensitive receptors at speeds below 3 m/s (between the hours of 6 am and 10 pm when people are likely to be outside around the NWWTP) has been assessed and is provided in Table 7.

This criterion is used as low winds have the greatest potential to carry odour towards sensitive receptors downwind of the NWWTP. At higher wind speeds the mixing and turbulence dilutes the odour prior to it reaching sensitive

receptors. This provides an assessment of the frequency of high-risk meteorological conditions for odour events and results using onsite.

Table 7: Frequency potential sensitive receptors are downwind at < 3 m/s

Sensitive Receptor	Land Use	Frequency	hours/year	days/year
Nelson City Council (Applicant)	Scenic Reserve Boulder Bank	2%	168	7
	Road (Boulder Bank Road)	5%	427	18
	Wakapuaka Sandflats Esplanade	4%	337	14
	Wakapuaka Sandflats Esplanade	3%	285	12
His Majesty the King	Wakapuaka Sandflats Esplanade	4%	337	14
Nelson Port	Wakapuaka Sandflats Esplanade	8%	741	31
The Proprietors of Wakatu	Rural land	8%	741	31
AA Singleton A R Higgins	Rural land	10%	888	37

Rainfall may mitigate potential for odour and reduce frequency of exposure to odour, however in this case taking rainfall frequency into account is likely to result in a negligible difference to the frequencies reported (based off AWS 4271 rainfall frequencies > 1 mm).

Table 7 shows that four of the identified potential sensitive receptors which are council land, and land reserves and will be downwind from the odour source (as determined by the impact arc) on days with winds below 3 m/s for less than 5% of the time during daytime. This could be considered as 'Infrequent' (less than 5%).

There is one potential sensitive receptor identified as downwind on days with winds below 3 m/s for 5% of the time which is the public coastal recreational area due to its expanding west to northeast. This can be considered as 'moderately frequent' but can also be attributed to the size of the sites meaning it extends along large portions of the NWWTP site boundary. Only parts of this site will be affected by potential for odours travelling downwind at any given time, never the whole site.

There are three potential sensitive receptors identified as downwind on days with winds below 3 m/s for 8 - 10% of the time which are the rural land areas and Nelson Port land. This can be considered as 'frequent'. These sites are not expected to have people present on them often which could be affected by potential for odours travelling downwind at any given time.

7.1.2 Intensity

Intensity can be assessed on a seven-point intensity scale as shown in Table 4 from no odour (0) to extremely strong odour (6). While this is subjective (different people will perceive odours as different intensities), it provides a useful quantitative tool for estimating odour intensity.

Table 8: Odour Intensity Scale (MfE, 2016)

Odour Intensity	Intensity Level
Very strong	5
Strong	4
Distinct	3
Weak	2
Very weak	1
No odour	0

Odour observations were taken by PDP and are presented in Appendix B around the NWWTP site on 13 and 14 April 2023. The weather was mild, with winds blowing from the southeast and with recent rainfall having occurred in the days prior to the site visits. NCC was operating the clarifier and trickling filter at the time of the observations to ensure potential odours with these components could be captured.

Observations were taken onsite directly next to the NWWTP components as well as 'off-site', which for the purposes of this assessment is actually still within the boundary of the wastewater treatment plant parcel but is accessible by the public (this being the coastal road and walkways).

No observations were taken outside of the NWWTP site boundary except for one observation made standing on the beach approximately 40 m downwind of the screens. This picked up 14 observations of very weak to weak odours out of 60 taken over a 10 minute period:

- 7 of these observations were sea or marine odours not associated with the NWWTP;

- 6 of these observations were musty or oily fatty odours potentially associated with the NWWTP; and
- 1 being indeterminate due to the very weak nature of the smell.

No other observations were taken outside the NWWTP boundary due to the wind direction (NW) at the days of the site visit, blowing from the southeast toward the coast at an average of 1.5 m/s as measured by a handheld anemometer. At the time of observations the intensity level off site could be considered at a maximum intensity level of '2' based on observations.

Of the odour observations taken onsite around the different NWWTP components varied between no odours and strong odours. The most frequent odours being observed adjacent to the inlet screens and clarifier. This means the intensity onsite could be considered at intensity level '0' to '4' based on the observations taken on the 13 and 14 April 2023.

Discussion with site operators outlined some circumstances where intensity may be more than observed on the site visit days of 13 and 14 April 2023. Circumstances where intensity increase have been noted by NWWTP operators include:

- Clarifier start up (approximately half a day where anaerobic material at the base of clarifier is turned up).
- Inlet screen fluctuations (hot days or higher residence times in pipelines prior to entering screens, higher loading from industrial dumps into the system).
- Pond inlets (when loading is higher than normal, loading was low at the time of observations, so this did not have an odour).
- Pond failure (if not desludged regularly and anaerobic conditions occur).
- Desludging (if leaks in sealed system or sludge spills are not cleaned up).

These circumstances have potential to produce odour intensities levels '4' to '5' if not well managed, and due to public access close to the NWWTP (inside the site boundary, but outside safety fencing) may expose public to high intensity odour in these limited conditions. The 'Odour Management Boundary' proposed in Figure 4 allows for some unavoidable odours related to these activities but does not allow for colossal failure of odour systems or pond failure which would result in offensive and objectionable odours beyond the 'Odour Management Area'.

Under normal operation circumstances, the intensity however can be considered low or maximum level '2' beyond the boundary of the NWWTP.

Given the extremely close proximity of the boundaries to the odour sources, this level of odour is considered appropriate and managed within the 'Odour Management Boundary'.

7.1.3 Duration

The NWWTP operates 7 days a week, 24 hours a day to meet Nelson's wastewater treatment needs and therefore the duration of the activity is consistent and episodic.

Under normal operation circumstances as observed on 13 and 14 April, the duration of the activity is undertaken with a low intensity odour. Should uncommon circumstances as described in Section 7.1.2 be experienced, this duration will be at a higher odour intensity for public at the NWWTP.

Desludging occurs once approximately every 10 to 15 years and can be continuous for prolonged periods until completed. When undertaken this activity can be considered continuous.

7.1.4 Offensiveness

Odour character is what the substance smells like. However, because individuals perceive odour individually, the same chemical may be described quite differently by different people.

Odour character can also change with concentration. For example, butyl acetate has a sweet odour at low concentrations, but smells like banana at higher concentrations. Table 9 gives a scale for rating the 'offensiveness', or hedonic tone, of an odour.

Table 9: General hedonic tone (offensiveness) (MfE, 2016)

–4	Extremely unpleasant
–3	
–2	
–1	
0	Neutral
1	
2	
3	
4	Extremely pleasant

While hedonic tone and offensiveness are subjective, PDP has used odour observations undertaken taken at the existing NWWTP along with experience around other WWTPs to estimate the possible hedonic tone ranges and offensiveness, with comments including around reasoning behind the estimations. These are presented in Table 12, Appendix B.

Overall, during normal operation of the NWWTP, it is expected that adjacent to the treatment units there may be odours of neutral (0) to slightly unpleasant (-1) offensiveness, however there is potential for operation variability and upsets to generate odours of higher offensiveness.

7.1.5 Location

The sensitive receptors identified within the NWWTP Odour Management Boundary have varying levels of sensitivity to odours, however given the types of sensitive receptor present, all the sensitive receptors adjacent to the NWWTP are expected to have moderate sensitivity being public recreational users, land reserves and rural land.

Odour observations taken at the location of the downwind sensitive receptor (public coastline) approximately 40 m from the existing NWWTP screens on a normal day of operation (clear weather following recent rainfall, light winds variable around 1.5 m/s, which are ideal for undertaking odour observations) detected no odour to weak odour which was characterised as sea (marine), musty/earthy/mouldy and oily fatty. The site operator noted the weak oily fatty odours could be associated with rainfall and stripping of oils and fats from wastewater pipes into the treatment system. Musty/earthy/mouldy odours can commonly be experienced at WWTPs.

Public technically have access to the NWWTP land area, and a public roadway runs directly adjacent to the wastewater ponds with little to no setbacks and a security fence for safety. Figure 11 demonstrates the minimal separation that could result in potential exposure to odours.

Figure 11: Photo of public access road immediately adjacent to NWWTP ponds

The public coastal walkway is frequently as close as 40 m to the different treatment stages which does not achieve as large amount of distance for dilutions of any odours generated. The three key sources for odour generation next to the walkway and how these can be managed are:

1. Inlet screens – Measures to improve odours from the inlet screens have been discussed in Section 6.0 and 7.4 to ensure offensive and objectionable odour effects to public are avoided.
2. Clarifier and Trickling Filter – Additional cleaning or draining procedures could be implemented to avoid a small layer of wastewater being left at the bottom of the clarifier and becoming anaerobic prior to the next use.
3. Ponds - Odours for the ponds are generally neutral hedonic tone and low intensity and are not expected to cause offensive and objectionable odour effects to public provided the measures outlined in Section 6.1 are implemented.

With regard to the rural land users and the Nelson Port land to the southeast of the NWWTP with frequent winds, the same controls for the pond as above result in low likelihood of offensive and objectionable odour effects at this site. This land is not expected to have as many people using the site and therefore the frequency of exposure will be low compared to the public walkway.

Residential land users would be considered high sensitivity; however, the nearest receptors are over 400 m from the NWWTP site boundary. Therefore, if effects of odour are managed to not be offensive and objectionable to those sensitive receptors right adjacent to the boundary, there should not be effects at further distances for these high sensitive receptors either. Section 4.4 outlines the complaints history which records when these residential sensitive receptors were

affected by offensive and objectionable odour effects from the ponds and Section 6.4 outlines how this is mitigated such that it will not happen again.

When desludging occurs and the geobags containing the sludge are transported to landfill, the contractor will develop and use a bespoke OMP to ensure the variety of sensitive receptors along the roads used by trucks are not exposed to offensive or objectionable odour effects. It is noted that the sludge will be aged and therefore less likely to generate offensive odours from PDP's previous experience with aged sludge in geobags.

7.1.6 FIDOL Summary

The findings of the FIDOL assessment indicate that, if not appropriately managed, there is the potential for acute off-site odour effects to visiting public at the Boulder Bank Drive carpark and walkway from the inlet screen. While rural land users and the Nelson Port land may frequently be subjected to winds favouring odour conditions, these areas not expected to be subjected to odour often as it is unexpected public will often be present in these areas for prolonged periods. The potential for all other sensitive receptors to experience odours that are offensive or objectional is extremely low due to the frequency, intensity, and pond management in place at the site.

In conclusion, it has been determined that while distinct to strong odours are immediately present directly adjacent to NWWTP treatment components, and subsequently where public access is allowed, effects are not expected to offensive or objectionable beyond the property boundary as a result of the NWWTP if the mitigation and management measures set out in Section 6.0 are implemented in conjunction with the additional mitigation recommended in Section 8.0.

7.2 Generator Air Discharges

Screen3 (version 4.0.1), a conservative screening model developed by the United Stated Environmental Protection Agency, has been used to approximate the ground level concentrations associated with the generator discharge. The dispersion model was set up for simple terrain, using full meteorology (all stability classes and wind speeds) with a discrete receptor distance of 20 m assessed, as this is the closest NWWTP west boundary fence with Boulder Bank Drive.

Receptor height is measured at 1.5 m from the ground to estimate the ground level concentration a person may be exposed to at each discrete distance.

The discharge rates for each of the contaminants of concern has been approximated using the National Pollutant Inventory (NPI) emission estimation technique manual for combustion engines – Version 3.0 (National Pollutant Inventory , 2008) Table 49: Emission factors (kg/kWh) for stationary small (less than 450 kW) diesel engines. A discharge velocity of 30 m/s is assumed with

an ambient temperature of 15 °C and stack temperature of 190 °C, and diameter of 150 mm.

The rates of discharge for the contaminants of concern have been calculated as:

- PM_{10} – 0.08 g/s;
- NO_2 – 0.24 g/s; and,
- CO – 0.24 g/s.

Final concentrations are based on the assumption the generator is tested for maintenance checks for 1 hour once a month. This is conservative as PDP understands that the generators normally operation for 30 minutes. Results are shown in Table 10 focussing on the highest concentration at the nearest site boundary (20 m to the west).

Table 10: Predicted Generator Discharge Concentrations (µg/m³)

Contaminant	AAQG Concentration	Background (Waka Kotahi , 2023)	Estimated concentrations with generator discharge	Averaging Period
PM_{10}	50	16.0	22.3	24-hour
	20	6.1	16.2	Annual
CO	30,000		490	1-hour
	10,000		61	8-hour
NO_2	200	4.5	**450**	1-hour
	100		23	24-hour

Notes:

1. *Concentrations in **bold** exceed relevant guidelines*
2. *Concentrations are taken at 20 m from the discharge source based off this being the nearest site boundary.*

The results show that all predicted concentrations with the exception of 1 hour average NO_2 are less than the AAQG concentrations. As mentioned above, the generator is proposed for emergency purposes only, and needs to be tested regularly (30 minutes per month) to ensure it is operable for these purposes. In addition, the outcomes of the model represent the worst-case concentrations at the least favourable meteorological conditions for dispersion. To experience this concentration the testing of the generator would need to align with the worst-case meteorological conditions which would be rare circumstances. This 1-hour NO_2 exposure is therefore expected to be highly infrequent, and it is unlikely that anybody would be in the immediate vicinity of the nearest boundaries (standing adjacent to the fence while testing occurs) to be exposed to these concentrations.

It is expected that the effects of discharges form the generator are expected to be negligible, and risks of any person being exposed to NO_2 above the 1-hour averaging period extremely low.

7.3 Greenhouse Gas Emissions

NCC has engaged T&T (Tonkin & Taylor Ltd, 2022) to measure and record and report its GHG footprint in terms of their Scope 1, 2, and 3 emissions for all wastewater activities. This section of PDP's assessment summarises the finding relevant to the NWWTP from T&T's report.

Scope 1 emissions associated with the NWWTP are predominantly from the treatment of the wastewater. To estimate these emissions, seasonal accumulation chamber surveys were conducted over a year by T&T to account for variation in operational and environmental parameters. Average annual emissions of 5,151 t CO2-e/yr (Tonkin & Taylor Ltd, 2022) were estimated across these four surveys. Vehicle use at the NWWTP was also accounted for, with an estimated 21 t CO_2-e per year of emissions associated with transport of sludge.

Scope 2 emissions are indirect emissions associated with purchased energy by the organisation. Emissions from electricity usage at the NWWTP were estimated using a total emissions factor of 0.1167 kg CO_2-e/kWh (which is the MfE 2020 emissions factor for electricity usage with transmission and distribution losses included[4]), resulting in 44 to 51 t CO_2-e per year of emissions from energy usage.

Scope 3 emissions are all indirect emissions that occur in the value chain of an organisation and have been excluded the purposes of GHG assessment for consent renewal at the NWWTP site with the exception of transmission and distribution losses as accounted for above.

Table 11 presents a summary of the GHG emissions for Scopes 1 and 2 of the NWWTP.

[4] Transmission and distribution losses account for 0.0097 kg CO_2-e (Ministry for the Environment, 2022) of this value and technically should be classed as a Scope 3 emission source.

Table 11: Summary of GHG Emissions from NWWTP	
Source	**Estimated Emissions (t CO_2-e / yr)**
Scope 1	5,151
Scope 2	44 to 51
Scope 1 & 2	**5,195 to 5,202**

The renewal of the consent for NWWTP does not include any proposed changes, indicating that GHG emissions and the existing environment will remain unchanged, therefore a neutral emissions impact is expected with no net increase or decrease in expected operational GHG emissions.

Increased wastewater loads of biochemical oxygen demand (BOD) and nitrogen (N) which may be experienced with future population growth in the next consent duration will result in an associated increase of methane and nitrous oxide generation from the ponds, wetlands and ocean outfall. However, an increase in GHG's with increased loads are expected from any WWTP process and the immediate impact can still be considered neutral as the design is staying the same, and loads in the immediate term will not be increased.

7.4 Cumulative Effects

There are no surrounding sites which have potential for discharge activities which may result in cumulative effects with regard to odour. Rural activities from surrounding properties have small potential for odour, e.g. silage feeding, however these are generally small isolated and temporary odour discharges. Therefore, the potential for cumulative odour effects is considered to be extremely low.

There are no other significant industrial discharges in the vicinity of the NWWTP beyond existing background concentrations which may add to cumulative contaminant concentrations greater than estimated in Section 7.2.

All GHG emissions cumulate in the earth's atmosphere and contribute to climate change warming effects. As demonstrated in Section 7.3, the overall effects are expected to have a neutral emissions impact, with no net increase or decrease in GHG emissions associated with the renewal of the consents to continue operation of the NWWTP.

8.0 Recommendations

From PDPs site observations on 13 and 14 April 2023, the inlet area has the greatest potential to cause objectional and offensive effects beyond the property boundary on a frequent basis. The clarifier, TF and ponds have potential to generate odour when loading is high, however pond management appears effective at present to manage the odour from the ponds.

PDP considers onsite odours could be better managed on a day to day basis with some upgrades of the existing odour mitigation measures. Therefore, we recommend the following measures be implemented, with the first one being necessary and the other measures being as required:

- improved air extraction capacity to draw more air from the wet well through biofilter treatment; and
- upgrading and increasing the size of the biofilter to improve odour treatment capacity once air extraction capacity is increased, introducing:
  - moisture control: At present this is not monitored, and operator judgement is relied on for moisture control. This can be improved by the use of handheld, moisture meters or further enhancement could be permanent meters linked to automatic sprinkler control; and
  - Off-gas monitoring of H_2S could be implemented to measure efficacy of biofilter operation.
- seeding the trickling filter prior to start-up when pond loading is high and the pre-treatment facility is required; and
- an improved clarifier cleaning procedure to practically remove residual wastewater from the base once emptied to avoid this aging and generating odours on start-up during the next high loading period;

PDP acknowledges some of these measures have been noted by Nelmac staff or are suggested in the existing OMP but may not yet be implemented, which are outlined in further detail in Section 6.9.

9.0 Conclusion

PDP have undertaken an air quality and greenhouse gas assessment for the purposes of resource consent renewal for the NWWTP. The potential discharges assessed were odour and combustion emissions from the generator as well as GHGs.

The impact of GHGs from this proposal were assessed as neutral due to there being no fundamental change in the wastewater treatment operations as part of this renewal.

The impacts of the emergency generator monthly testing indicated negligible effects on air quality with the exception of 1-hour average NO_2 concentrations

which will exceed the AAQG concentration limits if testing or emergency operation of the generator is undertaken during the worst meteorological conditions for dispersion. It was considered that this circumstance is unlikely to occur in conjunction with a person being present at the fence of the site boundary during operation and therefore the risk of a person being exposed to this exceedance is very low.

PDP have undertaken site visits to the NWWTP and a FIDOL to assess the potential effects of odour to be offensive and objectionable beyond the boundary of NWWTP. It was determined that for most sensitive receptors there is an extremely low (no significant) potential for them to experience offensive or objectionable odours.

However, for the public coastal walkway and carpark directly adjacent to the inlet screens at Boulder Bank Drive there is currently the potential for offensive or objectionable effects to occur within the Odour Management Boundary. PDP acknowledges air extraction to mitigate these effects is in the process of being upgraded and considers that if this is done correctly this will appropriately mitigate the effects. Therefore, on the basis the recommendations in Section 8.0 are implemented along with continuation of existing mitigation and management, objectionable and offensive effects would not be expected beyond the boundary of the property.

10.0 References

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Appendix A: Process Description

Inlet Works

Raw wastewater flows from the northern catchment of Nelson City to the Neale Park Pump Station by a variety of gravity and pressure mains. The wastewater is screened and then pumped to the inlet works of the NWWTP via the nine-kilometre long, underground Atawhai rising main alongside SH6.

Grit is removed by the horizontal grit chamber installed in the inlet channel to protect downstream equipment from damage. The grit is collected in the grit sump and pumped to the grit classifier. The grit classifier consolidates the grit material and resulting water is returned to the inlet channel, upstream of the Screen. The grit extraction system operates automatically at programmed time intervals.

A passive bypass channel was constructed as part of the Inlet Works. During high flow events or when the step screen becomes blocked, influent wastewater will automatically flow over the bypass weir and into the bypass channel. The bypass channel has stop logs to alter its discharge point to divert flow to either the facultative pond (normal bypass operation) or the Inlet Pump Station.

Inlet Pump Station

During normal operation, all wastewater flows from the Inlet Works to the Inlet Pump Station. The Inlet Pump Station buffers out peaks in plant inflow and directs flow to the flow buffer, pre-treatment, or the facultative pond.

A fixed overflow weir within the pump station controls the flow to the facultative pond. Under normal operation, all flows less than 30,000 m^3/day are directed to the facultative pond.

The pre-treatment facility is currently only used if pond health conditions require the loading to the Facultative Pond to be reduced; in this situation all flows up to 30,000 m^3/day are directed to the pre-treatment facility.

The flow buffer pumps operate when the influent flow is greater than 33,700 m^3/day. There is a pump recycle to the Inlet Pump Station so the pumps can be exercised without pumping wastewater to the Flow Buffer.

The fixed overflow weir controls the flow to the Facultative Pond; wastewater from the Inlet Pump Station flows over the weir and into the pre-treatment bypass channel discharging to the facultative pond. This means influent wastewater can flow by gravity to the facultative pond regardless of the availability of power. The plant was designed so that approximately 3,700 m^3/day will flow over the weir when the influent flow is equal or exceeds 33,700 m^3/day and 30,000 m^3/day is being passed to the pre-treatment facility.

Flow Buffer

The flow buffer storage is an earth embankment pond with a capacity of 16,000 m^3. Screened wastewater is automatically pumped to the flow buffer storage during high flow events. After the high flow event has ended, the flow buffer storage volume is discharged by gravity to Interstage Pump Station No. 2 using a manual knife gate valve. To minimise the odour risk, the flow buffer is emptied as soon as possible after the high flow event and, if required, the flow buffer is flushed down using treated wastewater from the Final Wastewater Channel and a portable pump.

Pre-Treatment Facility

The pre-treatment facility comprises a primary clarifier and a trickling filter. The pre-treatment facility is currently only used if pond health conditions require the loading to the Facultative Pond to be reduced. Initially inflow is passed through the pre-treatment facility and sludge generated is discharged into the Facultative Pond (first operation mode). If further load reduction is required, sludge generated is thickened and tankered off-site (second operation mode).

The Primary Clarifier removes readily settleable solids, reducing solids and organic loads prior to secondary treatment by the Trickling Filter or the ponds. Flows up to 30,000 m^3 can be passed through the clarifier. Flows enter through a stilling well and clarified water flows over a V-notched weir at the perimeter of the clarifier to Interstage Pump Station 1. Settled sludge in the Primary Clarifier is raked to its central sump and then either discharged into the facultative pond via Interstage Pump Station 2 (first operation mode) or pumped to the Unthickened Sludge Storage Tank (second operation mode).

Interstage Pump Station No. 1 was designed to split the flow from the Primary Clarifier between the Trickling Filter and the Facultative Pond. During normal operation, a portion of the flow is pumped to the Trickling Filter by the duty pump based on flow to the Primary Clarifier and the remainder flows over a weir to the Facultative Pond.

The Trickling Filter was designed to reduce the BOD load prior to further treatment in the ponds. It was designed as a roughing filter, which is a high-rate filter suitable for high organic and hydraulic loading rates. The rotating distributor sprays the clarified wastewater over the filter media, and it is treated by the attached biofilm as it passes down through the media. A minimum wetting rate and ventilation rate must be maintained to achieve effective BOD reduction. The treated flow, bypass flow, recycle rate, dosing rate and rotation speed can all be adjusted to optimise the trickling filter performance. Filter wastewater collected in the underdrain gravity flows is then pumped to the Facultative Pond.

The Trickling Filter was designed to be flushed one to two times per day to prevent the build-up of excess biomass, increase the aerobic surface area and improve overall treatment. A daily flushing cycle was intended to be carried out automatically during a low flow period (12am to 4am), with a second flushing cycle to be carried out during the day if required. Supernatant from the primary clarifier and recycled trickling filter wastewater was intended to be used for flushing, with trickling filter feed pumps ramped up to design flushing flow rate, trickling filter recycle pumps ramped up to maximum flow rate to reduce volume removed from the primary clarifier, and valve opened to minimise the risk of disturbing the sludge blanket in the clarifier and introducing sludge into the trickling filter.

Facultative Pond, Maturation Pond and Wetlands

Wastewater flows via gravity through the Facultative Pond (P1), then the Maturation Pond (P2) and then, typically, the wetlands. A brief overview of the current operation of each follows.

The Facultative Pond (P1) has a surface area of 16 ha, an average depth of 1.5 m, and four surface aerators positioned to minimise hydraulic short-circuiting. The primary function of P1 is to reduce organic and suspended solids concentrations, however it will also provide some initial pathogen reduction. Treatment is provided 'naturally', through the interaction of sunlight, wind, algae and bacteria. The level of treatment depends on several factors including organic loading, hydraulic retention time (accounting for short-circuiting), climate and season (both temperature, sunlight and wind), mixing/stratification, algal population (algae concentration, species type and health as well as algal grazers), wastewater physical characteristics (temperature, pH, dissolved oxygen), and sludge inventory. Wastewater from the Facultative Pond gravitates to the Maturation Pond via a pond transfer structure, designed to minimise algae and sludge carry over to the maturation pond.

The Maturation Pond (P2) has a surface area of 10 ha, an average depth of 1.5 m, and is partitioned into three zones to promote plug-flow. The primary function of P2 is to reduce pathogens. Treatment is provided 'naturally' through various mechanisms including sunlight exposure, grazing by protozoans and invertebrates, and retention time. A manual bar screen is located at the outlet of the Maturation Pond. The wastewater from the Maturation Pond flows by gravity to the flow splitter box, where effluent is typically directed to the wetlands but can be diverted to the Final Wastewater Channel, bypassing the wetlands.

The wetland system consists of two surface flow wetlands (Wetland 1 and Wetland 2), with a combined surface area of 13 ha. The wetlands typically operate in parallel, with the flow split equally to the two wetlands. Wetland cycling has been trialled successfully for past two summers to reduce algal solids,

with all flow directed to one wetland for a period to allow solids to reduce in the other wetland, and then all flow is directed to the other wetland. Each wetland is made up of three deep cells (about 800 mm deep) and two shallower cells (about 300 mm deep). The shallow areas were designed to be planted with appropriate wetland plants, however the plants have all but died. The wetlands essentially now act as an extension of the Maturation Pond, further polishing the wastewater. The wastewater from the Wetlands flows by gravity to the Final Wastewater Channel.

Overflow weirs are used to control the water level in the pond and wetlands. They can be used to balance flows within the pond-wetland system.

The health of the pond and wetland systems is monitored daily. Several mechanisms can be used if needed to maintain pond health, including using the pre-treatment facility to de-load the Facultative Pond (either with sludge discharged to the Facultative Pond or sludge thickened and tankered off-site), dosing sodium nitrate to the Facultative Pond inlet (manhole 3) to minimise risk of anaerobic conditions, and reseeding algae from another pond or wetland using relocatable pipework and seeding pump.

Discharge System

Treated wastewater from the wetlands (or maturation ponds if the wetlands are bypassed) gravitates via the Final Wastewater Channel and then a 900 mm pipe under the pre-treatment works to 'Manhole Y' and the offshore ocean outfall, discharging into Tasman Bay. The Final Wastewater Channel is an open, earthen embankment channel that is approximately 9 m wide and 3 m deep.

Solids Treatment

The solids treatment comprises an Unthickened Sludge Storage Tank, a Rotary Drum Thickener and a thickened storage tank. Solids treatment is not frequently used (once in last two years for a period of less than a month). Typically, when the pre-treatment system is required to be operated, the primary sludge from the clarifier is directed back to the facultative pond via Interstage Pump Station No. 2 (first operation mode). However, if the loading to the facultative pond is required to be further reduced, the solids treatment system is operated as outlined below, with thickened sludge tankered off-site (second operation mode).

When operating, the sludge treatment system operates on a batch basis. It was designed to thicken primary sludge from 2.5-4% dry solids concentration to 6-8.5% dry solids concentration, however this has not been achieved recently.

Primary sludge is pumped to the Unthickened Sludge Storage Tank, which has a volume of 144 m^3, equivalent to three days of storage during normal operation. The tank is equipped with manual decant valves at various depths which allows for a degree of in-tank sludge thickening for use during maintenance or the thickening plant if offline.

Unthickened sludge is transferred to the Flocculation Chamber where a polymer is added and mixed to promote polymer bridging. The sludge and polymer mixture flows over a weir to the Rotary Drum Thickener.

The duty Rotary Drum Thickener is equipped with a polyester filter cloth to separate the flocculated sludge from free water. The sludge moves along the length of the drum to the sludge discharge point. The rotary drum is equipped with a spray bar for continuous cleaning of the filter media.

The Thickened Sludge Storage Tank is equipped with a mixer and has a volume of 72 m^3, which is equivalent to two to five days storage during normal operation. When the sludge treatment system is operating, the thickened sludge is tankered off-site five to six times per week. The thickened sludge is transported to the Bell Island NWWTP, where it is treated to Grade A biosolids, pumped to Rabbit Island and then sprayed to a Pine Plantation.

Desludging

Desludging the oxidation pond is undertaken by dredging, dewatering and storing the sludge in geotextile bags on-site in the buffer pond and disposing the dewatered sludge to the York Valley Landfill. Desludging is undertaken infrequently but as required for the ponds to improve the oxidation pond capacity. As set out in the Nelson Wastewater Treatment Plant Desludging Operation Report (MWH, 2013), sludge will be removed from the facultative lagoon by dredging with the sludge being stored in geotextile bags. This process will involve:

- A dredger will be floating on the facultative pond.
- The dredger will suck sludge from the bottom of the pond and discharge the sludge into the geotextile bags via enclosed pipeline system. The transfer will be accomplished as a closed process.
- Pipelines will be laid above ground and will be located from the dredger in the oxidation pond to the geotextile bags. This may involve the pipeline being laid across the top of the outlet channel from the wetlands. Where the pipeline crosses the outlet channel, a temporary structure may be required to support the pipeline. The location of this temporary structure will vary as the project progresses.
- A flocculant will be injected into this pipeline to effect the separation of solids from the sludge prior to placement in the geotextile bags. The exact type of flocculant that will be used is currently not known as this will be up to the successful contractor to determine, however ‘Crystalfloc’ has commonly been used in such dewatering processes and is an organic polymer powder that binds strongly to the solids (i.e., sludge).
- Desludging may occur up to 24 hours per day, seven days per week (worst case) but this is dependent on the successful contractor’s timeframes.

Appendix B: Odour Survey Results Summary

The observations undertaken for odour on 13 and 14 April were taken downwind of the treatment components and NWWTP as far as practicable for the south easterly wind. Figure 12 shows where these observations were taken.

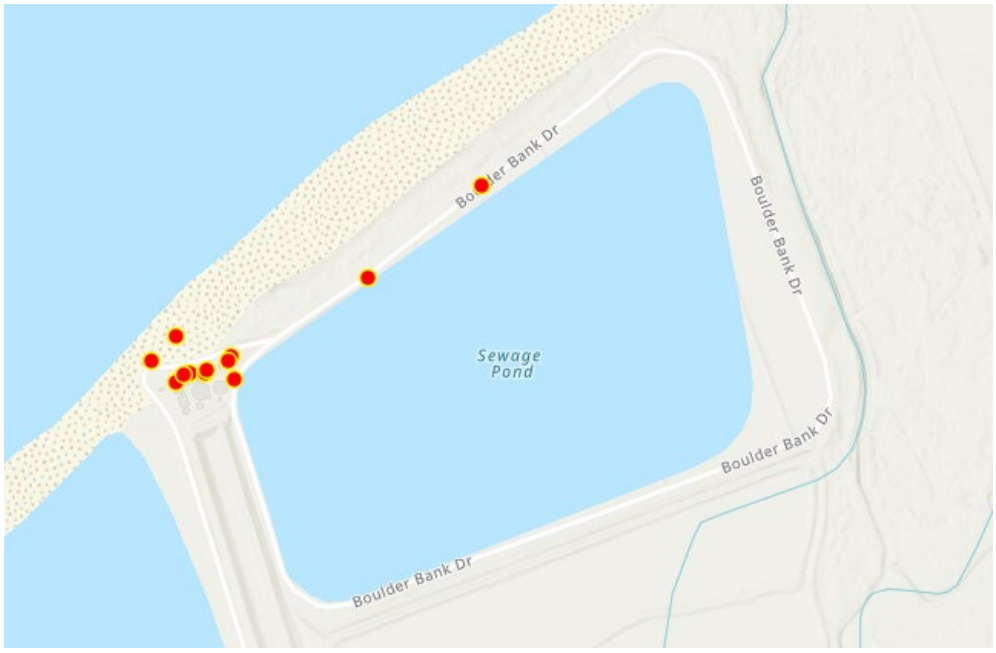


Figure 12: NWWTP with odour observation locations on 13 and 14 April 2023

The numbers of counts out of 60 observations taken over approximately 10 minutes at each observation spot where odour was observed are presented in Figure 13.

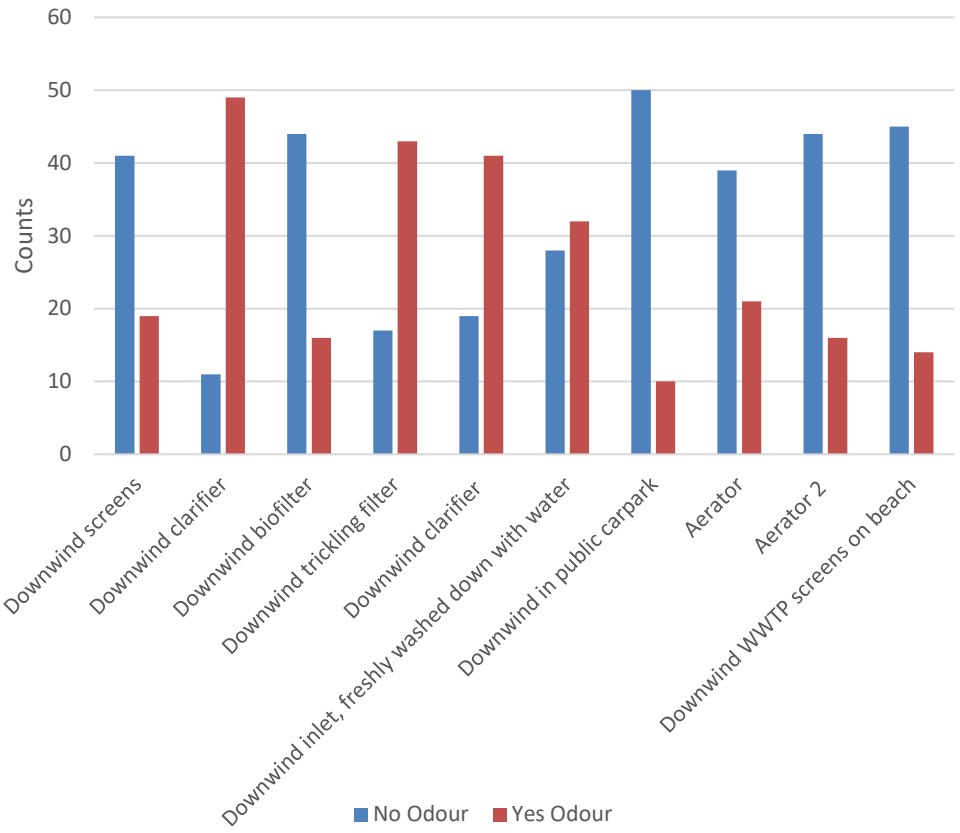


Figure 13: Odour detection at different points on 13 and 14 April 2023

Table 12: Estimated hedonic tone and expected offensiveness of each NWWTP odour source

Odour Source	Observations	Estimated hedonic tone range	Expected offensiveness (descriptors)
Inlet Channel Inlet Pump Station Screens	No odour to strong odour detected immediately adjacent to the inlets, estimated to have a hedonic tone between -1 and -4 depending on intensity. Intensity significantly lessons with distance from the screens.	-1 to -4	Unpleasant with potential to be extremely unpleasant with higher intensity (H_2S/sulphur, musty, earthy or mouldy).
Primary Clarifier	No odour to distinct odour detected downwind, between 0 and -2 depending on intensity. Odour sources were likely from the inlet still due to the proximity as odours matched the sulphur smells from the inlet and not what is expected from the clarifier. The aged anaerobic material not removed from the bottom of the clarifier when taken offline have the largest potential to cause odour, this was not detected when observations were taken as the clarifier had been operating for a few days.	0 to -2	Unpleasant (oily fatty, sewer, sulphur (from inlets))
Trickling Filter	No odour to distinct odour detected downwind, between 0 and -2 depending on intensity. Odour sources were likely from the inlet still with some interference from the biofilter due to the close proximity of the components. Odours matched the sulphur smells from the inlet and this has potential to mask other odours.	0 to -2	Unpleasant (oily fatty, sewer, sulphur (from inlets), bark-like (from biofilter))

Table 12: Estimated hedonic tone and expected offensiveness of each NWWTP odour source

Odour Source	Observations	Estimated hedonic tone range	Expected offensiveness (descriptors)
Biofilter	No odour to the occasional distinct odour downwind of the biofilter. Estimated between 0 and -1 for hedonic tone. More commentary regarding the biofilter is found in Section 6.0 and 7.4.	0 to -1	Neutral to unpleasant (bark-like)
Unthickened Sludge Storage Tank Rotary Drum Thickener Thickener Room Thickened Sludge Storage Tank	Not in operation during site observations, however as all the thickening rooms and tanks are sealed and covered respectively, odours are expected to be contained and neutral.	0 to -1	Neutral to unpleasant (oily fatty)
Facultative Pond (P1) Maturation Pond (P2) Wetlands Final Wastewater Channel	No odour to distinct odours were observed downstream of the facultative pond. This mostly had a neutral hedonic tone. Should loading on the pond increase there is potential for increased odours.	0 to -1	Neutral to unpleasant (soapy, musty/earthy or mouldy)
Desludging	Desludging was not in operation during the site observations, however provided this is undertaken in an appropriately sealed system, and sludge is sufficiently aged when transported to landfill, odours are expected to be contained and neutral.	0 to -2	Neutral to unpleasant

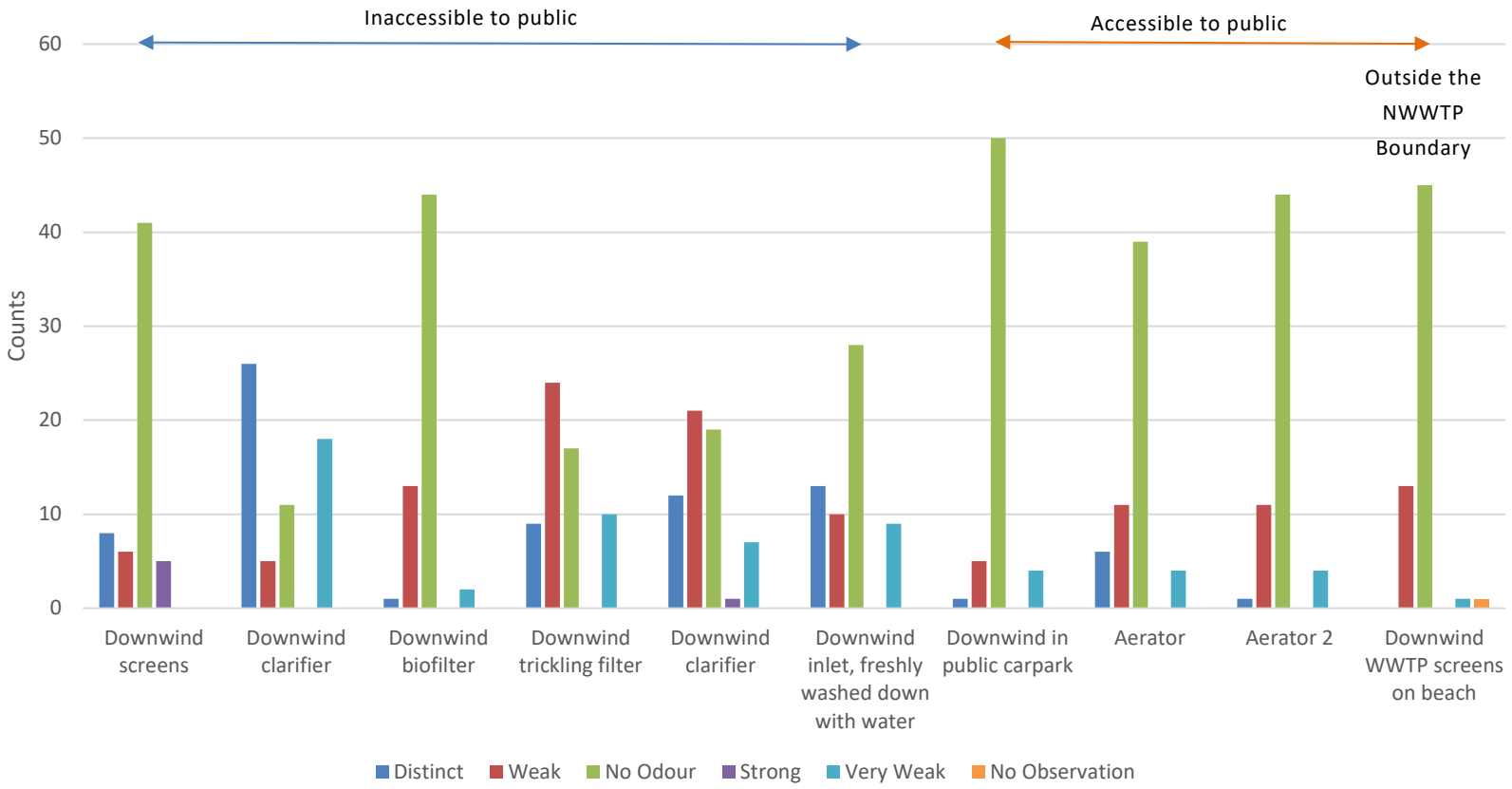


Figure 14: Intensity of odours observed on 13 and 14 April 2023 at different locations

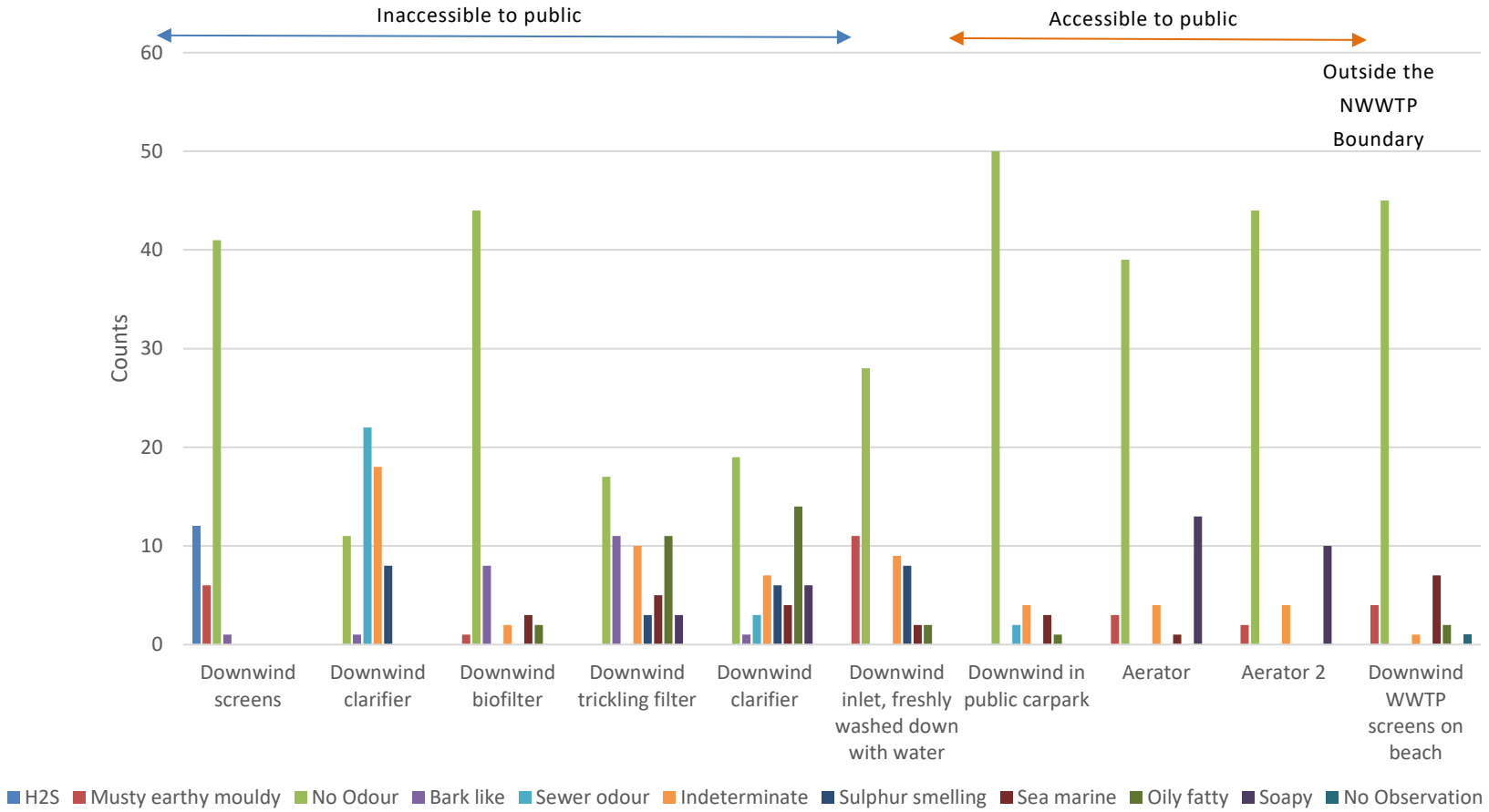


Figure 15: Character of odours observed on 13 and 14 April 2023 at different locations.

Appendix C: Odour Management Plan

Nelson Wastewater Treatment Plant
Odour Management Plan V1

February 2022

NRSS Odour Management Plan

TABLE OF CONTENTS

Appendices

Appendix A: Discharge to Air Consent

1 Introduction

This is an Odour Management Plan for the Nelson Wastewater Treatment Plant (NWWTP). Its purpose is to define how the Treatment Plant will be managed and operated to minimise odours so that discharges to air comply with the resource consent section 5.8

This plan should be read in conjunction with the Pond Management Plan which outlines best practices and operating philosophy to successfully operate the ponds and mange odours that can result from poor pond performance

1.1 Scope

This is an Odour Management Plan. It covers procedures for management of odours from the NWWTP treatment plant site. It does not cover odours from any of the reticulated pump stations that convey wastewater to the site.

The ultimate goal of this plan is to minimise odours so that discharges to air comply with the resource consent and so that any adverse environmental effects are minimised.

For NWWTP, this plan covers the general operation of the:

- Inlet works (screening and grit removal)
- Pre-treatment system (primary clarifier, trickling filter)
- Oxidation ponds (facultative, maturation ponds and the wetlands)
- Solids handling (Sludge storage tanks and Rotary drum thickener)
- Biofilters (Plant and RDT room)

A separate Pond Management Plan covers management of the Facultative Oxidation Pond, Maturation Pond and the wetlands, and to a certain extent, the pre-treatment stream. Control of odour from these systems is best achieved by proper management of them. This being the case, there is little need for specific odour management in addition to the Pond Management Plan. This Odour Management Plan reflects that and refers to and relies on the Pond Management Plan to a certain extent.

This is not an Operations and Maintenance (O&M) Manual. O&M aspects will be covered separately under the specific O&M manuals for the system.

2 Potential Health Impacts of Hydrogen Sulphide

Whilst this is an Odour Management Plan, the range of compounds that may be a source of odour nuisance from the NWWTP may also have a significant health and safety and corrosion impact.

The primary component, (particularly in inlet works and networks) is Hydrogen Sulphide (H_2S) which also has significant health and safety and corrosion impact. However, there are numerous other compounds such as ammonia, mercaptans, dimethyl sulphide, volatile organic carbons (VOCs), and cyanobacteria which may also have both health and safety and odour impacts. H_2S is considered in this section only to provide a brief overview of its potential impacts. Nelmac has a separate Health and Safety Manual and Standard Operating Procedures (SOPs) that addresses these risks.

Table 2-1 presents the health impacts of H_2S across a range of exposure levels. This is reproduced from the World Health Organisation (WHO) study of the human health aspects of hydrogen sulphide, 2003 (with monitor amendments). H_2S related concrete corrosion may be associated with levels even lower than 10 ppm and accelerated at higher levels.

Table 2-1: Human Health effects of H_2S

Exposure (ppm)	Effect / observation
0.008	Odour threshold
2	Bronchial constriction in asthmatic individuals
3.6	Increased eye complaints
5 – 10	Increased blood lactate concentration, decreased skeletal muscle citrate synthase activity, decreased oxygen uptake
3.6 – 21	Eye irritation
20	Fatigue, loss of appetite, headache, irritability, poor memory, dizziness
>100	Olfactory paralysis
>400	Respiratory distress
>500	Death

Table 2-2 presents the Worksafe New Zealand published exposure limits for H2S which are intended to protect human health resulting from workplace exposures to air pollutants. The limits are published in the Workplace Exposure Standards and Biological Exposure Indices (June 2016) which presents limitations on 8-hour Time Weighted Averages (TWAs) and 15 minute Short Term Exposure Limits (STELs).

Table 2-2: Exposure limits for hydrogen sulphide

Source	TWA (Time Weight Average – 8 hour)		STEL (Short Term Exposure Limit – 15 minutes)	
	ppm	mg/m3	ppm	mg/m^3
Worksafe, Nov 2020	5	7	10	14

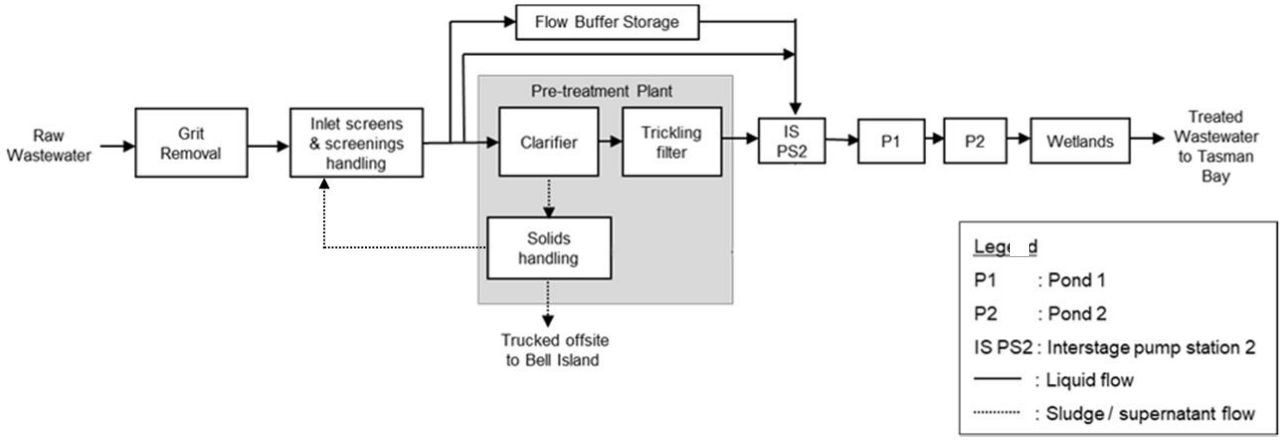
https://www.worksafe.govt.nz/dmsdocument/20238-workplace-exposure-standards-and-biological-indices/latest

3 NWWTP Plant Description

3.1 NWWTP Plant Description

The following is a broad overview of the Nelson WWTP to inform the Odour Management Plan. For details, refer to the separate O&M Manual(s) for the plant.

Figure 3-1: Treatment Flow at NWWTP[1]



- Wastewater flows to the Neale Park pump station by a variety of gravity and pressure pipes. It is then pumped to NWWTP via the underground Atawhai rising main alongside SH6.
- Flow entering NWWTP passes through grit removal then an inlet screen
- After the screen, flow either passes through the pre-treatment plant to P1 or passes directly to P1.
- The pre-treatment plant comprises a clarifier and a trickling filter
- Flow exiting P1 passes through P2 (which is partitioned into 3 maturation zones) and then wetlands (which are two cells in parallel), prior to being discharged to the Tasman Bay via the outfall. Levels in the ponds and wetlands can be adjusted to balance flows.
- During times of extreme wet weather, flow can be bypassed to the buffer storage pond. When inflows reduce, flow accumulated in the buffer storage pond is gradually directed back to the main treatment process.
- Solids from both the screen and grit chamber are sent to disposal.
- Sludge from the clarifier is either directed to P1 or passes through the solids handling facility (belt thickener) and is then trucked off-site to Bell Island WWTP. Supernatant from the Rotary Drum thickener is directed back to the inlet.
- Foul air collected from selected elements of NWWTP (including the inlet channel, inlet pump station, sludge storage tanks, thickened sludge storage tank, trickling filter and interstage pump station 2) is treated by a bark biofilter. A new odour system has been installed specifically for the RDT. It is noted that, at the time this plan was written, the performance of the existing odour system is currently being assessed/ recalibrated.

  ** NOTE – Review to be completed and findings included in the next review of the OMP

During power outages, a standby generator is available with an automatic changeover switch that will start the generator and automatically switch the plant to generator power. This allows the inlet flow to continue to be pumped through the per-treatment plant if required and to power the odour extraction systems.

4 Discharge to Air Consent

A copy of The NWWTP consent, “Consent to discharge contaminants, namely wastewater treatment plant gases, to air from a wastewater treatment plant” is contained in Appendix A. It applies to the Nelson WWTP site.

Special Condition 5 requires the contractor to operate and maintain the Nelson wastewater treatment plant in a manner which employs best practicable options to prevent or minimise the discharge of objectionable or offensive odours.

Special Condition 6 requires that There shall be no discharges to air from the Nelson Wastewater Treatment Plant which – in the opinion of an Enforcement Officer engaged by the Nelson City Council to carry out air quality compliance monitoring– are objectionable or offensive at any point on or south of State Highway 6.

Special Condition 8 requires the preparation of an Odour Management Plan that shall cover amongst other things:

- Details of the operating and maintenance regime for the proposed pre-treatment plant.
- Details of oxidation pond management which relate to minimising the potential for odour production from the ponds (Refer to the Pond Management Plan)
- Details of the complaints procedure, record keeping and response procedure

This Odour Management Plan and the associated Pond Management Plan collectively meet the special condition requirements.

5 Odour Sources

Potential odour sources from the NWWTP include.

- Inlet screen.
- Grit chamber.
- Splitter boxes.
- Primary clarifier.
- Trickling Filter
- Facultative Oxidation ponds.
- Maturation ponds.
- Wetlands
- Rotary Drum Thickener
- Sludge holding tanks
- Plant bark biofilter.
- De-watering room activated carbon scrubbers.

The odour emissions are generally derived from anaerobic conditions in the wastewater and sludge. Inadequate cleaning of plant areas, for example greases and solids in the screenings area can also cause the release of odours.

6 Odour Management

6.1 NWWTP

Odour control at NWWTP falls into two categories:

1. Odour control through proper operation of plant.
2. Specific odour control features.

The potential for the WWTP to emit objectionable or offensive odours is low if the plant is operated and monitored effectively. However, while all best efforts are made to ensure this is the case, experience has shown that risks of fungal parasitism or rotifer grazing on the ponds can occur that is out of the control of the operations and management teams and can result in odurs.

Plant considered at a low risk of producing odours includes:

- Primary clarifier
- Splitter boxes
- Interstage pump station
- The Wetlands
- Discharge channel

Specific odour control is provided for plant considered to have a high potential to produce odours, including:

- Plant biofilter – treats odour emitted from inlet screen, grit chamber and trickling filter.
- Activated carbon scrubber – treats odour emitted from the dewatering processes (Rotary drum thickener and dewatering room)

6.1.1 Inlet Works

The inlet works have a high potential for odour emission and are comprised of:

- Inlet flume
- Step screen and grit chamber
- Inlet pump station

Odorous gases can be produced in the rising mains leading to the site. It is then released in the high turbulence created at these plant items.

6.1.1.1 Odour Mitigation

The inlet flume, screen and grit chamber are covered, and air is drawn off to the plant biofilter (described in Section 6.1.6). The skip that collects screenings and grit is also covered but not connected to the odour system

Operational mitigation measures:

1. Inspect screens and mechanical equipment daily during working week.
2. Clean the screening systems (and, if necessary, the bar screen on the by-pass channel) by hosing down, on an as necessary basis, estimated at one to two times per week.
3. Empty the screenings skip on a weekly basis, or more regularly if warranted by an increased quantity of screenings.
4. Hose down and clean the screw press on a weekly basis.
5. Hose down and clean the skip pad area on a fortnightly basis.
6. Check bio-filter operation on a weekly basis (see Section 6.1.6).

6.1.2 Pre-treatment System

The pre-treatment system comprises the primary clarifier, and the trickling filter

6.1.2.1 Primary Clarifier

The Primary Clarifier receives pumped flows from the inlet pump station

Influent at the splitter box and clarifier should be sufficiently aerated, at the inlet screen and grit chamber, so that potential for odour is low.

6.1.2.1.1 Odour Mitigation

Operation of the Primary Clarifier is covered in its O&M Plan. This covers routine operator and maintenance procedures that will address potential odour. Specific operational activities to control odour are:

1. Inspect and clean scum boxes weekly.
2. Inspect and clean the central stilling well daily.
3. Inspect overflow weir weekly and clean as required, at least monthly.
4. Scraper arms (sludge and scum) are fitted with fail alarms, for early response to failure.
5. Prevent excessive accumulation of primary sludge in the primary clarifier by managing the depth of the sludge blanket by controlling the rate and frequency of sludge withdrawal to the sludge holding
6. Proactive maintenance to minimise failure
7. Removal of accumulated scum in scum wells as required.

6.1.2.2 Trickling Filter

Flow from the primary clarifier can be pumped onto the trickling filter for further treatment as needed.
Operation of the trickling filter is covered in the O&M manual.
The TF presents a high risk of odour due to the turbulence in the waste stream created when operational

6.1.2.2.1 Odour Mitigation

One of the primary functions of the trickling filter, aside from the pre-treatment benefits is the ability to remove sulphides from the wastewater which is beneficial from a pond management perspective.

The trickling filter is covered with a fiberglass dome and is connected to the plant biofilter to extract the gasses, it is important that the biofilter is operational when running the TF as it has a high potential odour risk.

6.1.2.3 Rotary Drum Thickener

The rotary drum thickener takes sludge from the primary clarifier and “de-waters” the sludge to reduce water concentration before transportation for processing off-site.
Use of the RDT is intermittent, typically during periods where the ponds are required to be de-loaded

This process is housed in a purpose-built building and has a high potential for odour generation when in operation.

6.1.2.3.1 Odour Mitigation

Operation of the RDT is covered in the O&M manual for it. This covers routine operation and maintenance procedures that will address potential odour caused by incorrect operation.

The RDT has a dedicated activated carbon odour system (covered in section 6.1.6) that keeps the sludge (wet) process separated from the rest of the treatment system.

6.1.3 Facultative Oxidation Pond

Management of the pond is detailed in the Pond Management Plan, one of the objectives of which is to avoid the emission of odours.

Odour emissions from the pond are generally associated with the disruption of biological processes. Potential causes of this are addressed in the Pond Management Plan, including:

- **Overloading of the ponds**. If inlet BOD loads in the influent to the STP are excessive, then the ponds will become overloaded.
- **H2S Toxicity.** Even at low levels H2S can be toxic to certain species of algae – an inlet analyser is being installed to monitor H2S levels. During high periods of H2S in the inlet the trickling filter can be used to strip sulphide.
- **High TSS loading.** Prolonged periods of shock high TSS loads can impact algae.
- **Fungal attack on algal populations.** If a fungal attack occurs then the algal populations can completely die off or else be significantly reduced. This reduction can lead to inadequate oxygen formation and reducing conditions beginning to occur. This risk is now the main odour risk factor associated with the ponds and may lead to major odour events, both in magnitude and duration.
- **Seasonal succession of algal species.** This is a natural and inevitable occurrence and gives rise to periodic, relatively minor odour events which will be on-going. A variety of factors are significant, including weather conditions (particularly pond stratification via wind assisted turnover).
- **Sludge build-up in the ponds.** Influent solids settle out within the facultative ponds, and to a lesser extent, the maturation ponds. Overtime this progressively reduces the hydraulic capacity of the ponds and, particularly during warmer months, the sludge contribute an increasing oxygen demand to the water column as it degrades. Desludging of the ponds is a reactive maintenance requirement. Further information is contained in the pond management plan.

The Pond Management Plan is focused around load management and pond performance. Standard operating and maintenance procedures for the ponds are covered in a separate O&M manual.

6.1.4 Maturation Pond

The maturation ponds receive effluent from the facultative pond. Provided that the facultative pond is properly managed as described above, and in the Pond Management Plan, the maturation pond is highly unlikely to emit odour.

6.1.5 Wetlands

The wetlands receive the effluent from the maturation ponds. There are two wetlands namely Wetland 1 and Wetland 2. Both wetlands can be isolated or have flows/ levels controlled independently of each other.

6.1.6 Biofilters

The main plant biofilter is a bark media with fixed sprinkler systems. Operation of the biofilters is covered in detail in the O&M manuals for them. The following covers aspects critical to odour control.

Moisture content of the media is critical to biological activity. At present this is not monitored, and operator judgement is relied on for moisture control. This can be improved by the use of hand held, moisture meters. A further enhancement could be permanent meters linked to automatic sprinkler control.

Media must be maintained at the correct pH level, as sewerage gases are often associated with low pH. pH correction by the addition of granulated lime or similar is recommended. pH measurement of media is carried out 6-monthly by the media supplier in conjunction with AFP (Air fill porosity) to determine the condition of the media. The supplier may recommend some addition of an additive to help correct the pH

Media effectiveness should be monitored regularly (6-12 monthly intervals) and media should be replaced when shown to be ineffective or at least every three to five years.

Regular inspections of the biofilters are carried out as follows to ensure they are maintained in an operable fashion:

- Weekly monitoring of manometer pressure differential <100mm
- Maintaining the bark in a weed free condition by regular weed spraying
- Visual checks for short-circuiting and turning over the bark at 6 monthly intervals
- Annual assessment of media pH and AFP to determine when the bark media required to be changed and if addition of lime or similar is necessary. These tests are carried out by the media supplier who provides a recommendation on media quality and when it is required to be replaced.
- Off-gas monitoring? H2S? Could be a future improvement to assess effectiveness of biofilter operation.

6.1.7 Dewatering Room

The dewatering room houses the Rotary Drum thickener (R.D.T) that can be used to receive primary clarifier sludge.

This unit is used periodically on as “as needed” basis when de-loading the ponds. Operation of the RDT is covered in the O&M manual for it.

Mitigation is by ventilation of the room and treating the air using activated carbon (AC) scrubber.
It is important to keep external doors and openings closed to minimise risks for odours escaping the room.

The activated carbon scrubber operation is covered by its specific O&M Plan, which details proper operation for effective odour control.

7 Response Procedures

The discharge to air consent (Appendix A) sets out the required information to be collected regarding odour complaints.

In practice, any complaints of odour are usually made directly to the Nelson City Council (NCC) Customer Services desks. The complaint and relevant details are then passed on to the operator for further investigation.

The formal process for odour notification is as follows

1) Customer contacts NCC call centre to log the event
2) NCC call centre raises a SR (Service Request) then contacts duty operator and advises of the details of the event and the name and contact details of the complainant
3) The duty operator follows up as required, contacting the complainant to gather any additional information required and determine if the call is to lay a complaint or is simply a notification of an odour. The operator is to visit the treatment plant, complainant’s property or both to ascertain the likely cause of the odour.
4) Record the details on the odour complaint log including notes on weather conditions, wind speed, direction etc.
5) Odour complaint log is then forwarded to the contract support team to close off the SR
6) Details of the complaint and investigation to be relayed to NCC compliance officer, as the representative for the consenting authority.

This information is recorded in an Odour Complaints Log which is maintained by Nelson City Council. The operator investigates the incident and reports back for upgrading the Odours Complaint Log. Odour events

are to be recorded by the contractor in InFor and reported without delay to the NCC contract supervisor or engineering rep.

Occasionally it may be necessary to carry out operational or maintenance activities that may result in odours (e.g. biofilter off-line for repairs?). Similarly, unforeseen or rapid changes within the plant could also lead to generation and release of odours.

In the event of any incident or activity that produces odour or is likely to produce odour, the NCC compliance officer will be notified.

8 Contingencies

Hazards/risks associated with the operation of the pond and wetlands are covered in the Pond Management Plan and/or the respective plant O&M manuals. The mitigations proposed there effectively address potential odour emissions.

Faults in treatment systems with odour extracted to the biofilters or activated carbon scrubbers may generate odour above normal. However, the odour control plant may attenuate the extra intensity of odour, however the extent of attenuation is not known.

Faults in the odour control systems themselves are addressed in the O&M manual(s) for these systems. These include faults in fans, ducting, media, irrigation, drains etc. In addition, the integrity of buildings, covers etc. and the proper control of inlet air, to avoid rogue emissions, is covered in the O&M manuals(s).

Loss of power supply at the Nelson WWTP will result in all inflows being diverted directly to the pond system. A back up generator is described in section 3.1
In the event of an issue with the plant generator there are a number of generators available locally that can be used in an emergency.

9 Plan Control and Revision

Version	Status	Date	QA	Distribution
V1 DRAFT	DRAFT for Revision	February 2022	Prepared by: Allan Jones (Nelmac) Checked by: Reviewed by: PMT Approved by:	Email
V1	Final	March 2022	Prepared by: Allan Jones (Nelmac) Checked by: Reviewed by: PMT Approved by: NCC	Email

Appendix A: Discharge to Air Consent

Odour section Pg.33 of consent Document